

ELECTRONICS

Australia

Incorporating RADIO, TELEVISION & HOBBIES

NOVEMBER, 1965

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Vol. 27

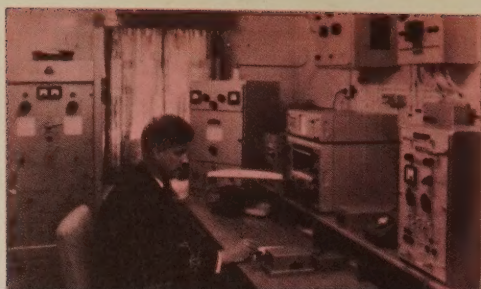
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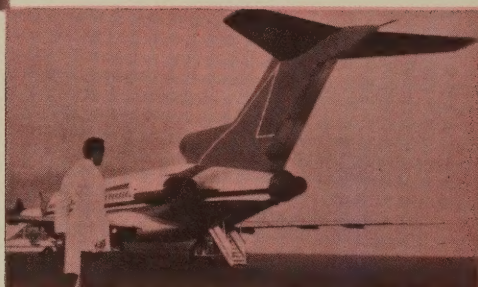
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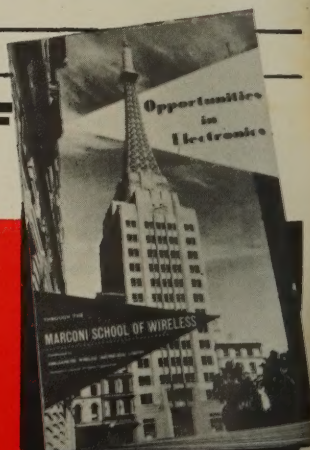
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cury," Hobart.

COVER PICTURE

In the red panel is an ordinary paper clip encircling a group of Fairchild "planar epitaxial complementary transistor micrologic" devices. The degree of magnification is apparent from the paper clip. The CuL 958, at the left of the group, is a decade counter involving four binary triggered flip-flops. Its circuit pattern, magnified still further, fills the rest of the cover.

UHF FM/STEREO

THE remarks, last month, in "Forum" could not have been more timely had they been taken from a crystal ball. To repeat: "Against this background an FM system, with stereo as an option, could easily assume very attractive proportions to the equipment industry, to the Government and to the retail trade alike."

Even while the issue was being distributed, John Bailey, A.W.A. consumer-products sales manager, was telling N.S.W. distributors that they should take up the cause of FM with their parliamentary representatives. He went on to say: "Not exerting firm pressure for FM in the VHF band, at the time when we had the opportunity to do so, has proved to be a disservice to the country."

Later, to a group of Victorian and South Australian dealers, he again championed the cause of FM—an apparent about-face for a firm which seemed biased all the other way at the A.B.C.B. inquiry some years ago.

Nor is the attitude unique. Other firms which then were starry-eyed about television are now taking a closer look at the proposition of FM/stereo in the UHF band. They are realising that it could open up an important new consumer market and one which, by reason of its unique character, would not be readily accessible to overseas competition.

On the engineering side, Mullard Australia have already delivered papers showing a way through some of the potential design problems. And, of course, two privately owned experimental stations are in process of construction.

But it would be wrong to assume that FM/stereo is almost here. Political, economic, industrial and technical situations all have to be the subject of inquiry and, in my book, this is going to add up to years, not months. And by that time the position relative to colour television may well have changed.

To conclude on a technical note, I doubt the wisdom of assuming that the optimum FM/stereo service will simply be present-day VHF practice transferred to UHF. It may be wise to take a long, hard look at the idea of multiple carriers or an intercarrier system, which may dodge some of the problems of multiplexing on the one hand and frequency drift on the other—not to mention inadvertant mistuning. We don't want to be in the position of showing the world how not to do it!

N. Williams

November, 1965

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INSTROL

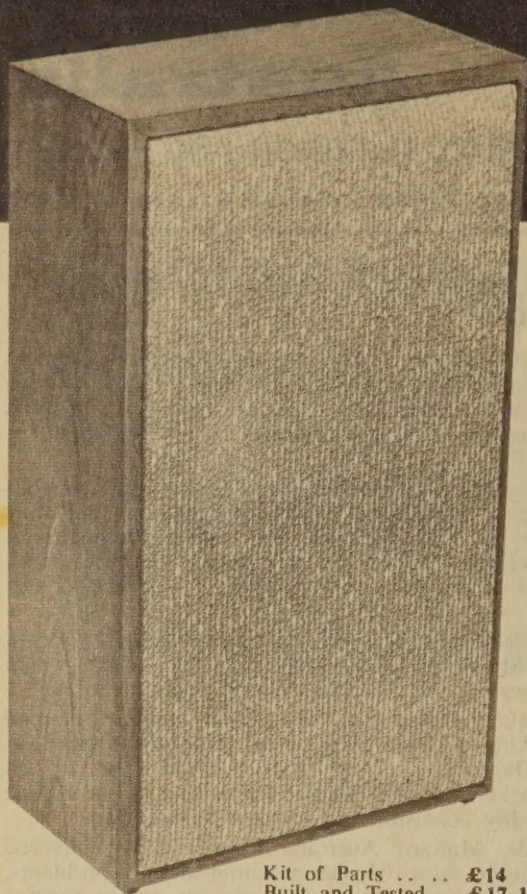
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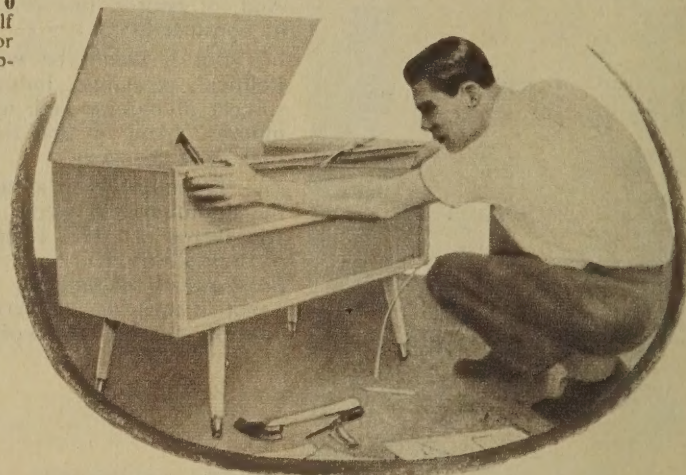
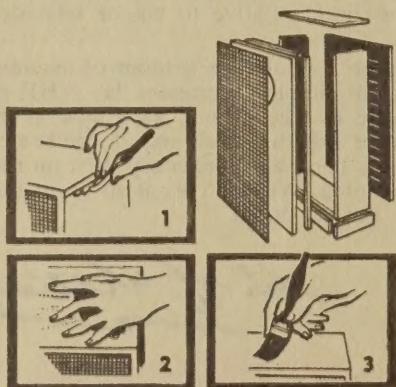
It's amazing, the reproduction is unbelievable for so little cost. Magnificent bass response with extreme clarity in the upper register. Performance equivalent to or even better than comparable imported units, yet less than one-third the cost. Produced precisely to this magazine's original specifications. This system is also available as a kit to build yourself, complete with instructions, two twin cone speakers, Innerbond acoustic wadding, plastic foam cabinet kit and all necessary components.

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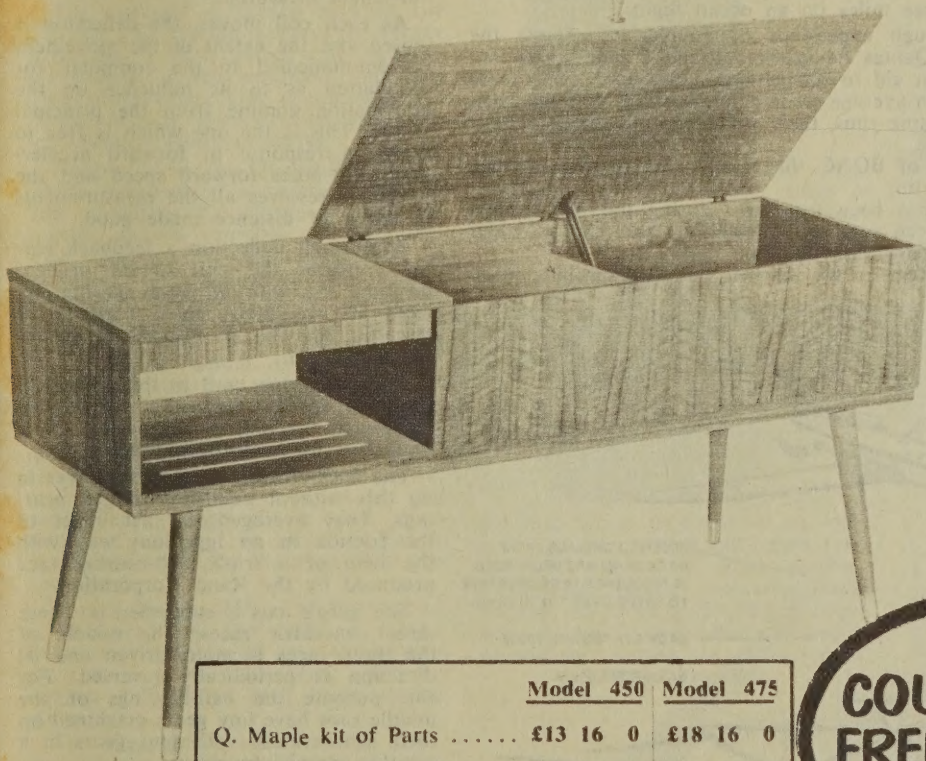
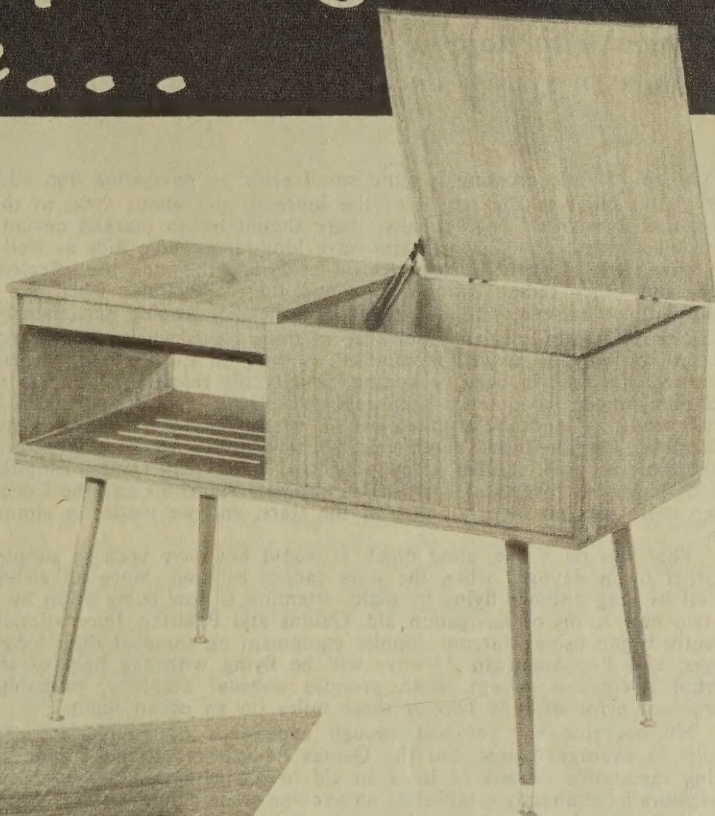
and then sandpaper the nail holes. (2) With a cloth, first rub on, then wipe off the filler paste. (3) With a brush, apply 3 coats of Estapol or similar. For a few shillings we can supply a polishing kit complete with simple instructions, sufficient to polish a complete setting of cabinets. Finishes available are Queensland Maple, Walnut, Rosewood, Scandinavian oiled Teak, etc. Instrol cabinet kits may be POSTED to any part of Australia. Instrol offers you a COMPLETE range of craftsmen-designed hi-fi furniture. Equipment, cabinets, and speaker enclosures, etc. All available in kit form or built and polished. We will also supply polished cabinets or kits to your special design.



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NAVIGATION WITHOUT THE STARS

Airline operators are fast becoming conscious of the economies that can come from the more accurate "starless" systems of navigation. The first Super VC10 airliners with doppler systems recently went into trans-Atlantic service. Inertial guidance, a system developed for spaceflight, is also being put into operation.

by E. Colston Shepherd

ON an Atlantic crossing a quite small error in navigation can add perhaps 300 miles to the length of the journey, and about £400 to the cost in extra fuel consumed. Theoretically, there should be no marked deviations from a planned course now that captains have long-range radio aids as well as celestial navigation at their service; yet on occasions the aids are affected by sun-spots and other radiation influences, and there are times when the heavenly bodies cannot be seen. The risk of errors in dead reckoning may then be serious.

This risk is of special importance in those areas where radio aids are non-existent, or are not so well maintained as those in Europe and America. Many instances of errors in dead reckoning, usually the result of drift, are on record and many more have never been reported. I was myself once in a flyingboat which made its landfall 80 miles too far to the west on a sea crossing of only 500 miles. On the other hand, celestial navigation, when it is possible, gives remarkably accurate results. A few years ago I flew with Qantas Empire Airways on the long sea crossing of 2,650 miles between Mauritius and the Cocos Islands, when there was no help but that of the stars, and we made an almost perfect run.

That was on a fine, clear night. It would not have been so simple in dirty weather or in daylight when the stars cannot be seen. Since an airline cannot do all its long distance flying by night, attention is now being given by operators to two new forms of navigation aid. Qantas and Pakistan International Airlines recently began using Marconi doppler equipment on some of their long non-stop stages; and Pan-American Airways will be flying with the help of the Sperry inertial navigation system. Both promise unusual accuracy, probably with a margin of error of only two or three miles on an ocean flight.

No operator has yet had enough experience of doppler to express the results in average figures, but the Qantas navigators on the Pacific stages are giving favourable reports of it as an aid to navigation in daylight. Since these navigators have already established an average error not exceeding 20 miles when using celestial observations on the same runs, their standards of judgment must obviously be high.

A few months ago, Super VC10s of BOAC, fitted with the doppler system, went into operation on the Atlantic run.

The Sperry inertial apparatus has been test-flown during the past couple of years and its performance has been such as to lead Pan-American to order 120 sets for its fleet, at a cost of around £30,000 a set.

This is not the only inertial system on the market; but it is specially inter-

esting because it breaks away from the earlier form of floating accelerometer as a means of measuring every movement of the aeroplane, right or left or forward, for computing in terms of distance made good along a predetermined track.

This type of detector, floating in liquid in a can, is free to move in every direction and so to supply the required information. It has to be carefully adjusted so that it has neutral buoyancy, and this means periodical topping up, and heating the fluid to the temperature at which the detector works.

The type developed by Sperry has no flotation fluid. Its sensitive element is a coil mounted between magnets in such a way that it can move only in the direction in which an indication is required.

With two of these, one free to move in the yaw axis and the other in the roll axis, the behaviour of the aeroplane can be continuously observed and each movement measured.

As each coil moves, the deflection is sensed and the extent of the movement is communicated to the computer for calculation as to its influence on the information coming from the principal sensor. This is the one which is free to move in response to forward accelerations. It notes forward speed and the computer resolves all the measurements in terms of distance made good.

After each deflection a feedback current restores the coil to its original position. As with all such sensing devices an absolutely stable platform is essential and this is ensured by means of gyroscopes.

The gyroscope used in this system is of special interest because of the method employed to reduce precession to a minimum by neutralising friction.

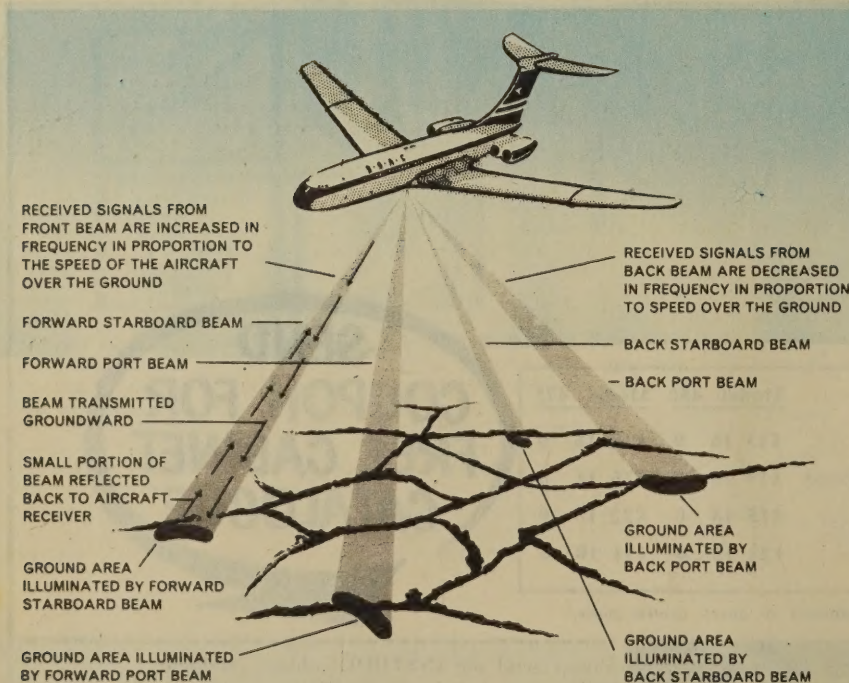
The Sperry designers set themselves to do this without resorting to gas bearings. They averaged the net effect of the friction in an ingenious way with the help of a triple ball-bearing race produced by the Rand Corporation.

The gyro's axis is supported on these three concentric races. The middle of the three races is motor-driven and its direction is periodically reversed. For this purpose the ball-bearings of the middle race have tiny gears machined on them which mesh with spur gears in a rotating aluminium sleeve.

As a means of neutralising the effects of friction by reversing it, this could only be effective, with the gyro spinning at 24,000 rev./min., if the period occupied in changing the direction were extremely small. Tests have shown that the process of reversal is completed in ten milliseconds.

To obtain such a measure of virtually instantaneous reversal means high-precision engineering, and fine work of this nature is now going on at the Sperry works at Bracknell in Berkshire.

The device is expected to give 1,000-



Two forward and two rearward looking beams are used in the Marconi doppler guidance system fitted to the Super VC10 airliners. When the frequencies of the return signals are compared with the original transmit frequencies, accurate ground-speed and drift-angle figures can be derived.

hours of service between component failures.

Whether the aid chosen to afford self-contained navigation guidance is inertial or doppler, it must be capable of at least as much accuracy as the best human navigator can show from shots at the stars with a bubble sextant and the subsequent calculations based on GMT and the star almanac.

Both seem now to have reached a stage of development at which they can promise a margin of error not exceeding plus or minus two miles on a journey of 2,000 miles.

This accuracy has yet to be confirmed in commercial operation, by experience over a period and in all kinds of conditions, but early reports appear to be good.

"Self-contained" is the key word in considering these aids. Every other navigational aid depends on some sort of transmission from the ground which is received and interpreted in the aeroplane. If either part of the system fails in the course of flight, the aid is not available.

Risk of failure cannot be removed by putting all the apparatus in the aeroplane, but it is halved at least and will be reduced still further if, as with Pan-Am, two sets are fitted in each liner.

A further advantage in providing each liner with its own independent guidance is that the maintenance of the whole system is in the hands of the user.

The essential difference between the doppler and inertial systems is simply explained. Both detect and measure movements by the aeroplane and feed their observations into a computer for resolution into terms of distance travelled along a specified course.

Doppler does this by sending downwards impulses of a known frequency and measuring the change in that frequency as the impulses are reflected. The change can be interpreted as distance. This doppler "shift" is proportional to the speed of the aeroplane over the ground, and because the shift is greatest along the line of motion of the aeroplane, actual direction can be determined and the angle of drift discovered.

In the Marconi system, four beams are sent out from the aeroplane's aerial, two to port and starboard aimed ahead, and two similarly aimed towards the rear. This arrangement is used as a means of aligning the aerial so that it matches exactly the flight path of the aeroplane.

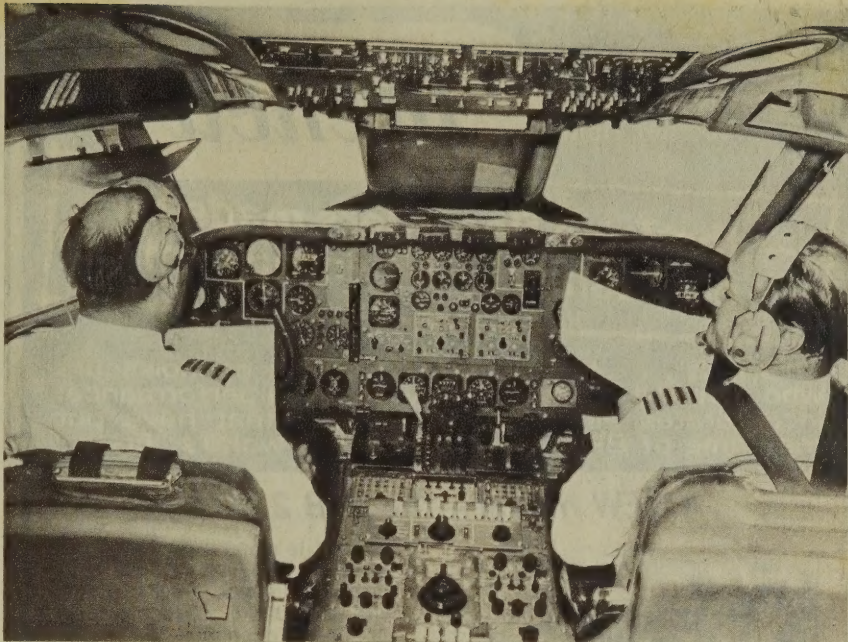
To this end the shift in all four beams is compared and the aerial is moved automatically about the axes of yaw and pitch by a servo mechanism, until the doppler shift from each beam is the same.

The alignment is with the flight path; the difference between this and the axis of the aeroplane, or the direction in which it is pointing, is the drift angle.

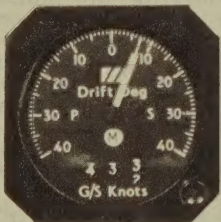
Over a number of years this system has been under trial and development; the development has been based on experience.

One improvement concerns the difference in the reflection of the beams from land and from sea. The effect of the waves on a conical beam is to produce a different shift in the front of the beam from that at the back.

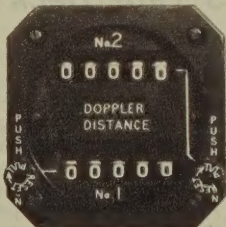
This was found to cause an error equal to about 1.2 per cent.



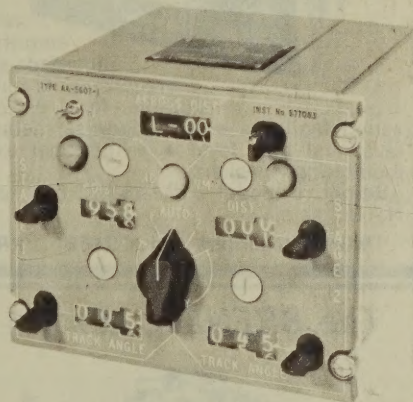
The cockpit of a VC10 airliner, fitted with the Marconi Doppler Navigator type AD560. Under normal flight conditions, the pilots can relax and eat a comfortable meal with no more than an occasional glance at the doppler dials to assure themselves that the plane is flying itself efficiently and on course. (Photo by courtesy of "Aeroplane & Commercial Aviation News.")



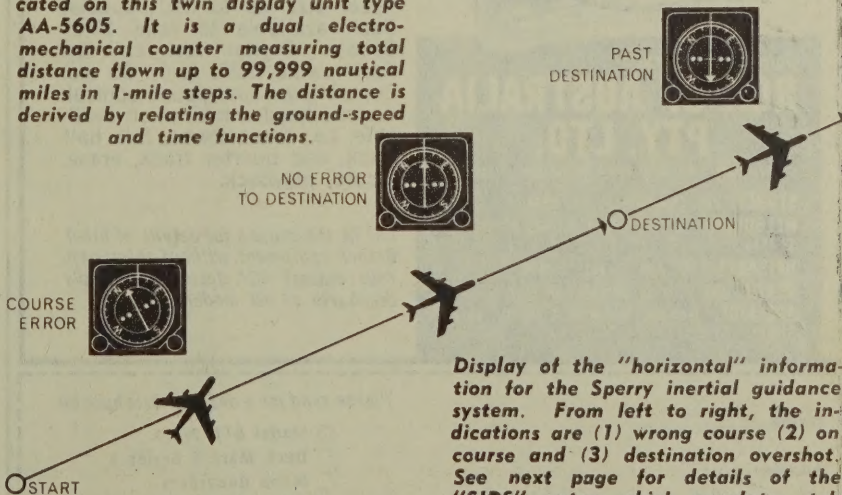
The Marconi ground-speed and drift-indicator type AA-5604-1. Drift is shown on the main dial, ground speed in knots in the digital display beneath.



Distance flown is displayed as indicated on this twin display unit type AA-5605. It is a dual electro-mechanical counter measuring total distance flown up to 99,999 nautical miles in 1-mile steps. The distance is derived by relating the ground-speed and time functions.



The doppler navigation control and display panel type AA-5607. (Equipment photographs by courtesy of the Marconi Company Ltd., England).



Display of the "horizontal" information for the Sperry inertial guidance system. From left to right, the indications are (1) wrong course (2) on course and (3) destination overshoot. See next page for details of the "SIDS" system which correlates stellar, inertial and doppler information for extreme orders of precision.

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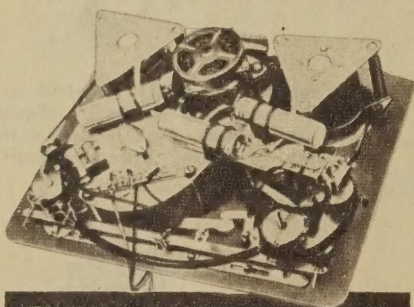


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The same difficulty might be expected
to occur over land; and in fact it does,
but the error averages itself out over
land (there is roughly as much uphill as
downhill terrain) whereas the "sea bias"
does not. So the design of the aerial has
been altered to secure beam shapes
which are less susceptible to this effect,
and in consequence the sea bias error
has been reduced to 0.25 per cent.

At one time there was trouble, too,
with what was called "height holes" —
critical heights at which the delay in the
return of the signal was equal to the
frequency-modulation interval, so that
the shift could not be measured or gave
an inaccurate result.

This was ingeniously met by what the
designers described as "wobulation," or
the sweeping of the modulation fre-
quency through 15 per cent either way
of its mean value, with the result that
the value of the critical height is con-
stantly being altered.

There has been plenty of evidence
that the developed system gives good
results in practice. Before Qantas
decided to fit it in its aircraft on the
Pacific run, a period of 750 flying hours
was devoted to evaluation.

The report showed a 95 per cent
probability of accuracy to within one
per cent of distance flown, with across-
track errors of less than 0.38 per cent
of distance flown. In the whole 750
hours there was no failure in the appar-
atus.

Marconi's doppler is being fitted to the
VC10s of B.O.A.C. and Ghana Air-
ways, and also into the DC8s of Tas-
man Empire Airways in New Zealand.

One point to be remembered about
doppler is that the aircraft heading must
be fed into it, to obtain from it guid-
ance in maintaining a given track. If
the heading is inaccurate there will be
an error in corrections. Care has there-
fore to be taken to make sure that the
heading measurement, whether from
magnetic compass or gyro compass, is
precise.

A basic reference has likewise to be
fed into the inertial system at the be-
ginning of a journey. This is the posi-
tion on the lines of latitude and longi-
tude of the place of departure. It can
be read off a chart; but it must be done
exactly and given to the system in de-
grees, minutes and tenths.

Having thus given the computer its
location (and this is done on the apron
before moving away for take-off), the
inertial system aligns itself with true
north by means of a gyro compass. It
make take 15 minutes to warm up and
it is then ready to accept, again in terms
of latitude and longitude, the position
of the desired destination or of succes-
sive way points or destinations, up to
a total of 10.

From now on, the system shows on
the instrument panel the navigational
situation in relation to the prescribed
track, or so controls the autopilot that
the track is followed.

On a long run, the desire to follow
a Great Circle course and so to take
the shortest route between two points
on the globe has normally meant flying
the track in segments of virtually
straight lines, changing course slightly
at the end of each segment.

The inertial system's computer works
out the proper Great Circle course and
prescribes a continuously changing line
to ensure that it is followed. A minia-
ture aeroplane, as in the artificial hori-
zon, shows the pilot whether he is

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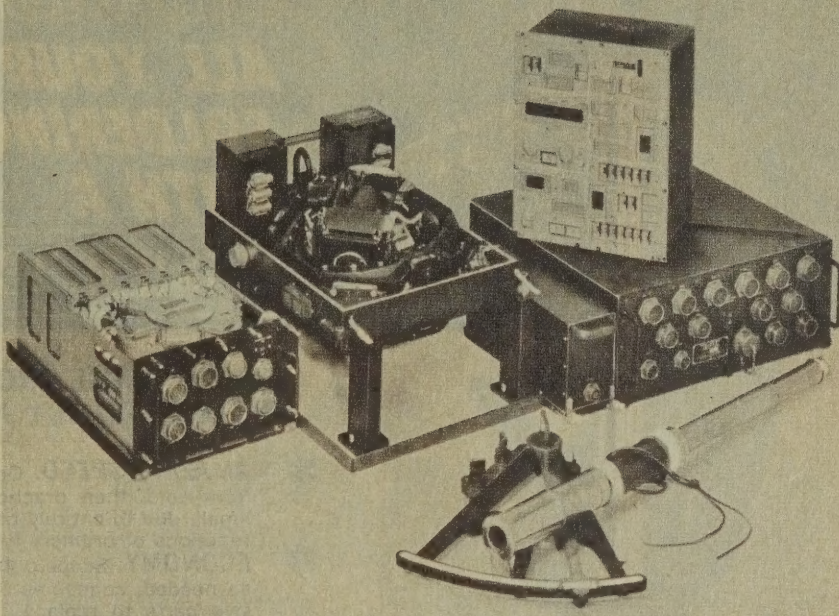
making good this track, or what correction he needs to conform with it.

If, on the way, he gets diverted to an alternative landing place, he can re-instruct the computer.

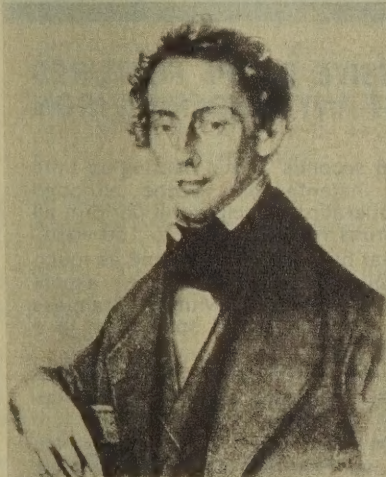
Provision is made for advising the pilot should he pass beyond his set destination. In this event, the direction bar on the instrument dial reverses itself through 180 degrees and points towards the rear. The doppler system is similarly supplied with a summary of the computer's conclusions displayed on the instrument panel.

They show the track angle, the distance to go and any across-track error as a distance in nautical miles. The

STELLAR-INERTIAL-DOPPLER SYSTEM



The recently accepted (SIDS) Stellar-Inertial-Doppler system and, in foreground, the traditional ship's telescope and sextant.



Christian Johann Doppler (1803-53) was the first man to attach significance to the changing note of an approaching locomotive's whistle. Because the same basic principles are involved Doppler's name is used to identify modern navigation equipment.

system can be coupled up with the autopilot and left to control it.

It can also be set up for two successive stages and an automatic change-over from one to the next takes place at the appropriate point. Further courses can be laid down as the flight proceeds.

A high degree of automatic navigation is afforded by both these systems. Pan-Am is so convinced of the benefits to be derived from the inertial system it has chosen that it has announced its intention of changing from four-man to three-man crews in the 707s in which the system is to be installed.

That is a prospect to which other users of automatic navigation may look when they have satisfied themselves of the behaviour of the apparatus in the hard usage that belongs to commercial operation in different climatic and other circumstances.

A marked reduction in the burden of navigational duties seems probable. How that is ultimately expressed in economic terms will be determined by evidence of reliability.

If, indeed, something between 700 and 1,000 hours of service between failures can be proved, there should be quite a notable saving in manpower to set alongside the almost certain saving in fuel consumption from a reduction in the average margin of error produced by normal methods of navigation. (Reproduced from "New Scientist" by arrangement.)

THE U.S. Air Force has officially accepted an advanced navigation system incorporating "the best features of three types of navigation systems in use in aircraft," according to George T. Scharfenberger, a senior vice-president of Litton Industries. Designated the AN/ASN-59, the Stellar-Inertial-Doppler or "SIDS" navigation system will provide the U.S. Air Force with continuous, automatic 24-hour, all-weather navigation to an accuracy much greater than previously obtainable in a lightweight system.

The basic method of navigation is inertial, as employed in newest Air Force and NATO jet fighters and U.S. Navy patrol and attack aircraft. The inertial subsystem automatically tells the pilot his position and the heading and distance to any of 90 destinations. It operates continuously without reference to the ground, sky or radio or radar beams.

- Velocity information from a doppler navigation system increases the long-range accuracy of the inertial system.

- The astro-tracker subsystem obtains star fixes to check the latitude and longitude position data indicated by the other subsystems.

- A computer processes the information from the three navigation subsystems, provides output signals for displaying navigation data on the control panels and performs computations necessary to control the SIDS system as a whole.

Most advanced feature of Litton's SIDS system is the astrotracker subsystem, which automatically tracks two or more stars in daylight, as well as at night, to determine the precise position of the aircraft, corrects the position indicated on the control panel and sends appropriate corrective gyro bias signals to eliminate the cause of the error.

Using position and heading information derived by the inertial subsystem, the computer predicts the elevation and bearing of predetermined stars, within the field of view of the astro-tracker subsystem at that time and position, and sends pointing angle commands to the tracker telescope. (The computer stores information on at least four pre-selected stars which will be in view at any time and point on earth.)

The telescope slews to the commanded pointing angles and, if a star is within the field of view, a "star presence" signal is generated, along with position signals indicating whether the star is left, right, above or below the centre axis of the telescope. The digital computer, upon receipt of these indications, generates control signals to centre the star in the telescope field.

If, within 15 seconds after slewing to the commanded elevation and bearing, there is no star presence signal, the computer will generate signals for a search which continues until a "star presence" signal is generated or the search time runs out. Then the telescope slews to another star. The elevation and bearing of any star is continually upgraded by the computer to compensate for vehicle motion and earth rotation.

The star-tracking telescope is mounted directly on the gyro-stabilised platform in the inertial system, eliminating alignment problems and related computations. The telescope was designed by Litton to provide the characteristics appropriate for this unique application without sacrificing size and weight.

The SIDS system is comprised of four units—an integrated stellar-inertial reference unit, platform tracker electronics, a digital computer and a display and control panel. The aircraft's standard doppler radar unit is employed with the SIDS system. Total system weight, exclusive of the doppler unit, is 232lb and volume is 5.85 cubic feet. The units can be separated by as much as 100ft, making the system applicable to many aircraft configurations.

Checkmate

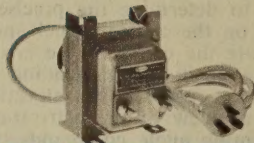
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Seventy Years in Australian Telecommunications

Standard Telephones and Cables Pty. Ltd. is currently celebrating its 70th anniversary. In its 70 years S.T.C. has developed from a small commercial office into an organisation which develops, manufactures and installs advanced electronic equipment anywhere in the world.

THE foundation for S.T.C. was laid when an office was established in Sydney in 1895 by the Western Electric Company. S.T.C. now owns and uses 750,000 sq. ft of floor space and employs 2,800 people.

The early history of the company is closely associated with the development of telephone communication in Australia. The Western Electric Company registered the Bell telephone patents in the "Australasian Colonies, Tasmania and New Zealand" as far back as 1878.

At this time white colonisation in Australia was less than a century old, and the continent was composed of a group of self-governing colonies with no common bond except ancestry and allegiance to the British Crown, and no common interests save those which geography and trade imposed upon them.

The actual advent of the telephone in Australia occurred two years after registration of the Bell patents, when, in 1880, the first instrument was installed in the colony of Victoria. This was about the same time that telephones were introduced into Europe.

Three years later the London branch of the Western Electric Co. commenced the export of telephone apparatus to the Australian colonies and, in 1895, opened an Australian office at Sydney. This date is regarded as the foundation date of S.T.C. Pty. Ltd.

For the first 30 years of its history the business of the Australian company was concerned almost entirely with importing and installing the products of its associated manufacturing companies in Great Britain and in other parts of the world. And, while embracing communication equipment of various types the bulk of it was mainly telephone apparatus for the Postmaster-General's Department.

In 1925 two important events occurred which had far-reaching effects on the progress and development of the Australian company. The first of these was the decision to commence manufacturing operations in Australia; the second was the acquisition of the company by I.T.T. and its change of name to Standard Telephones and Cables (A'sia) Ltd. The name has since been changed to Standard Telephones and Cables Pty. Ltd.

1927 saw the genesis of the Australian manufacturing business which started in a small rented factory at Chippendale, an inner Sydney suburb. Telephones were the first products of S.T.C.'s Aus-

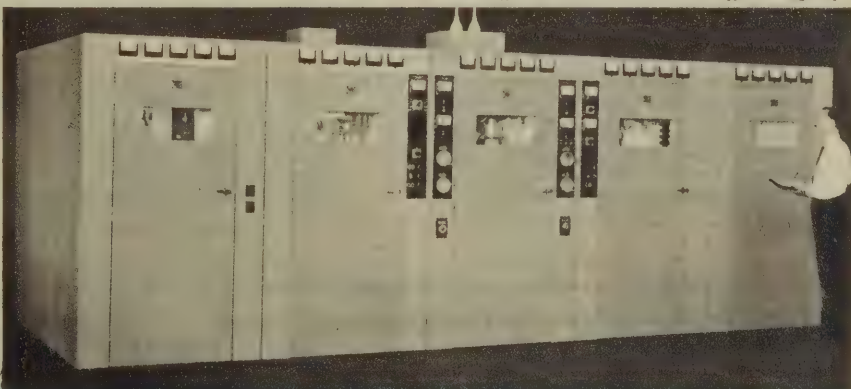


A non-directional, low-frequency (200 to 400KC) navigational beacon built and installed by S.T.C. Power output is 20 watts but the solid-state circuitry minimises current drain to simplify supply problems in remote locations. Power for the installation shown comes from a wind-driven generator mounted atop the mast to the right of the top picture.

tralian manufacturing venture, followed in quick succession by other types of telephone apparatus, radio receivers and radio transmission equipment.

In 1927 there were no economic indicators pointing to the run-out of the tide of national prosperity which was to usher in the great depression of the 1930s. Less than four years later this depression constituted a major setback to the fortunes of the Chippendale enterprise. The sales for each year from 1930 to 1934 tell their own story: £488,093; £242,792; £240,205; £222,758 and £307,301.

It is of great significance, however, that while total sales fell, the volume of sales from local manufacture increased, creating work at a time when unemployment



A typical high-power HF broadcast transmitter, engineered at the S.T.C. factory, Liverpool, N.S.W. Output power can be 50 or 100KW, and frequency within the range 3.2 to 28MC. Numerous medium and high-powered transmitters have been supplied to Australian broadcasting services, including four 100KW units for "Radio Australia." Transmitters are in service or on order for New Zealand, India, Thailand, Vietnam, Antigua, Leeward Islands and other countries. Special attention has been given to dual operation of transmitters, to guard against failure.



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1. Power Thyristor (Silicon Controlled Rectifier) **C6**.....1A @ TC=85°C/200V
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4. Power Diode **A40**.....20A @ TC=110°C/600V

For high voltage, General Electric silicon power semiconductors

5. Power Thyristor (SCR) **C145**.....35A @ TC=80°C/1300V
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10. High-Frequency Power Thyristor **C155**.....70A @ TC=70°C/500V
11. High-Frequency Power Thyristor **C185**.....150A @ TC=90°C/600V
12. Silicon Power Transistor **6B**.....60W @ TC=100°C/120V
13. Silicon Power Transistor **20A**.....30W @ TC=100°C/80V
14. Silicon Power Transistor **7A-T**.....4-40W @ TC=25°C/200V

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15. Power Thyristor (2N1595-99) **C5**.....1A @ TC=100°C/400V
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17. Power Thyristor (2N681-92) **C35**.....16A @ TC=65°C/800V
18. Power Thyristor (2N1909-16) **C50**.....70A @ TC=75°C/900V
19. Power Thyristor (2N2542-48) **C80**.....150A @ TC=80°C/800V
20. Power Thyristor **6RW75**.....300A @ TC=80°C/1000V
21. Power Diode **A70**.....100A @ TC=130°C/1200V
22. Power Diode **A90**.....250A @ TC=135°C/1000V
23. Power Diode **6RW62**.....200A @ TC=125°C/2000V
24. Controlled Avalanche Diodes (6 sizes).....0.5A to 250A, 500V to 1000V
25. Fast Recovery Diodes (4 sizes).....6A to 35A, 400V; t_{rr} =200 nsec Max.

... an SCR—but can I afford to put one in a light dimmer?” (See No. 2 at left)

... a thyristor designed for high frequencies—one that has low turn-off time.” (See No. 9)

... a silicon rectifier that can handle 80,000 peak watts in the reverse direction.” (See No. 24)

Spend a minute or two with the listings at the left, and you'll find that General Electric makes a silicon power semiconductor for almost any application you can think of.

You'll find one for a cordless shaver, another for a motor-speed control, still others for mighty industrial equipment and military applications.

While you think of it, clip the list. Or better still, ask for General Electric's free "Reference Guide to Silicon Power Semiconductors." It lists *twice* as many types as we do here, with detailed descriptions and photographs as well. Contact your G.E. representative or *General Electric Company, Dept. EC-65-01, 159 Madison Ave., New York, N.Y. 10016, U.S.A.*

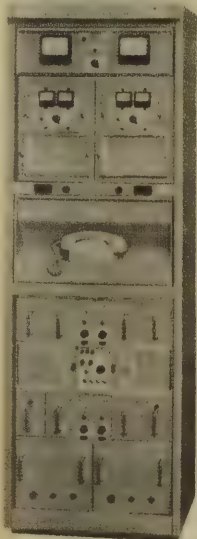
Australian General Electric Pty. Ltd., 103 York St., Sydney, N.S.W.

GENERAL  ELECTRIC
Trademark 1G27

ment was incredibly high. Local manufacturing in the period 1930 to 1934 was valued at £77,000; £126,000; £160,000; £140,000 and £161,000 for each successive year.

By 1935 the Chippendale factory was too small to house the company's expanding business, land was bought in the nearby suburb of Alexandria where the company erected a factory with an initial floor space of 30,000 sq. ft. This original factory is now the Alexandria machine shop. On the outbreak of war in Europe in 1939, the number of S.T.C. employees stood at 486 and the factory floor space had increased to 55,000 sq. ft.

The experience of World War II



A dual radio link transmitter / receiver of the type supplied to the Philippines for inter-islands telephone traffic. The unit pictured is predominantly solid-state but the later model, fully engineered in Australia, has all solid-state circuitry operating at 2000MC and carrying up to 600 telephone circuits or a TV program.

demonstrated the reliance placed by modern armed services on a steady and adequate flow of electronic and communication equipment. Supplies of this equipment from overseas were subject firstly to priorities established by the supplying country and secondly to the hazards of enemy action during transportation over long distances.

It was essential, therefore, that Australia should help herself and that industry should meet this challenge.

S.T.C. accepted readily its share of responsibilities in this task. Radio transmitting and receiving equipment, line transmission equipment, broadcasters, radar equipment, transmitting and receiving valves, rectifier equipment, army field switchboards and telephones, were some of the products manufactured and supplied by S.T.C. to all branches of the Australian and U.S. Forces in the Pacific theatre of war where tropical jungle conditions imposed severe design parameters on all equipment.

By the end of the war in 1945 it had been demonstrated clearly that Australian industry was capable of manufacturing sophisticated communication equipment.

The last 20 years of S.T.C.'s history, from 1945 to 1965, has been a period of overall expansion in which four events have great significance.

The year 1948 saw the establishment of the Liverpool factory on a large site some 25 miles from the heart of Sydney. By this time S.T.C. employees numbered 2,400 and the Alexandria factory had reached its building saturation point. Liverpool was intended to be, and has in fact become, the location for future expansion.

In 1961 a momentous decision was taken to discontinue the manufacturing

U.S. HONOURS BRITISH SCIENTIST



The United States Stuart Ballantyne Medal—"For outstanding achievements in the fields of communication"—has been awarded to British scientist Alec Harvey Reeves. His invention, the pulse code modulator, made possible the recent transmission of photographs from Mars to Earth. Mr Reeves originally conceived PCM over 25 years ago when working with Sir Robert Watson-Watt's team on pioneer radar development. It is anticipated that PCM will find many new communication applications in the near future.

and marketing of household electrical appliances. These were traditional S.T.C. product lines producing at that time 30 per cent of S.T.C.'s sales income. From then on S.T.C. was to concentrate on developing the engineering side of its business.

It is now a matter of record that, by 1964, the loss of gross revenue from the sale of household appliances had been more than replaced by increased revenue from engineering sales and, in fact, gross income in 1964 was an all-time company record.

In 1963, a contract to supply and install a microwave system from Brisbane to Cairns to complete the land-based link between the undersea Seacom and Compac cables represented the company's successful entry into the "turn-key" type of contract involving the planning, supply, installation and commissioning into service of a major communication system.

The fourth event occurred in March

of this year when the Commonwealth of Australia presented S.T.C. with an award in recognition of the successful results of three years of concentrated export endeavour. These export results proved that the company was able to sell Australian-designed and manufactured telecommunication equipment on the world market.

Looking ahead, S.T.C. is destined to undertake work on satellite communication systems; on laser phenomena which are being so actively explored and applied in various fields; on more extensive application of computer techniques to telecommunications; on advanced navigation, telemetry and remote control systems; transmission and switching systems using digital coding arrangements and on many other new developments.

These are techniques not even dreamed of in the commercial office of the Western Electric Company, Vickery's Chambers, Pitt Street, Sydney, Colony of N.S.W. in the year 1895.



Qantas House, Sydney, centre of the organisation's world wide communication system for seat reservations and administrative messages.

BOOKING AN AIRLINE SEAT

Although seemingly a simple procedure to the prospective passenger, booking a seat on an international airline flight involves a series of complex operations within the field of international communications. This article, and the one to follow, explains how the airlines are coping with the ever increasing demand on their communication and reservation systems.

By Calvin Walters

AIRLINE companies are among the largest operators in the international communications field, using their own teletype networks for a continuous flow of messages relating to passenger reservations, plus operational, engineering and administrative activities.

The largest private user of international communications in Australia is Qantas, whose communications centre is located in Qantas House, Elizabeth Street, Sydney, N.S.W. This centre handles all messages relevant to operating the large fleet of Qantas aircraft, flying at speeds of up to 600 miles an hour over 72,178 route miles throughout the world.

These services are also linked with those of other airlines, with the result that Qantas Telecommunications Department is involved in a vast and complex network, averaging an exchange of 18,000 messages daily at 1,000 an hour during peak periods. Last year nearly four million messages were handled at the centre.

Qantas, together with associated companies throughout the world, have co-ordinated their communication facilities

into a communications network called Overseas Fixed Telecommunications System, abbreviated OFTS. This coverage is augmented by another co-operative network known as SITA (Societe Internationale de Telecommunications Aeronautique). A glance at the accompanying map will reveal the worldwide coverage attained by these systems.

All the communication circuits, namely land lines, submarine cables, high-frequency and microwave links, etc., are owned by the public authorities of the various countries through which they pass. These circuits are leased by the various airlines for their own use.

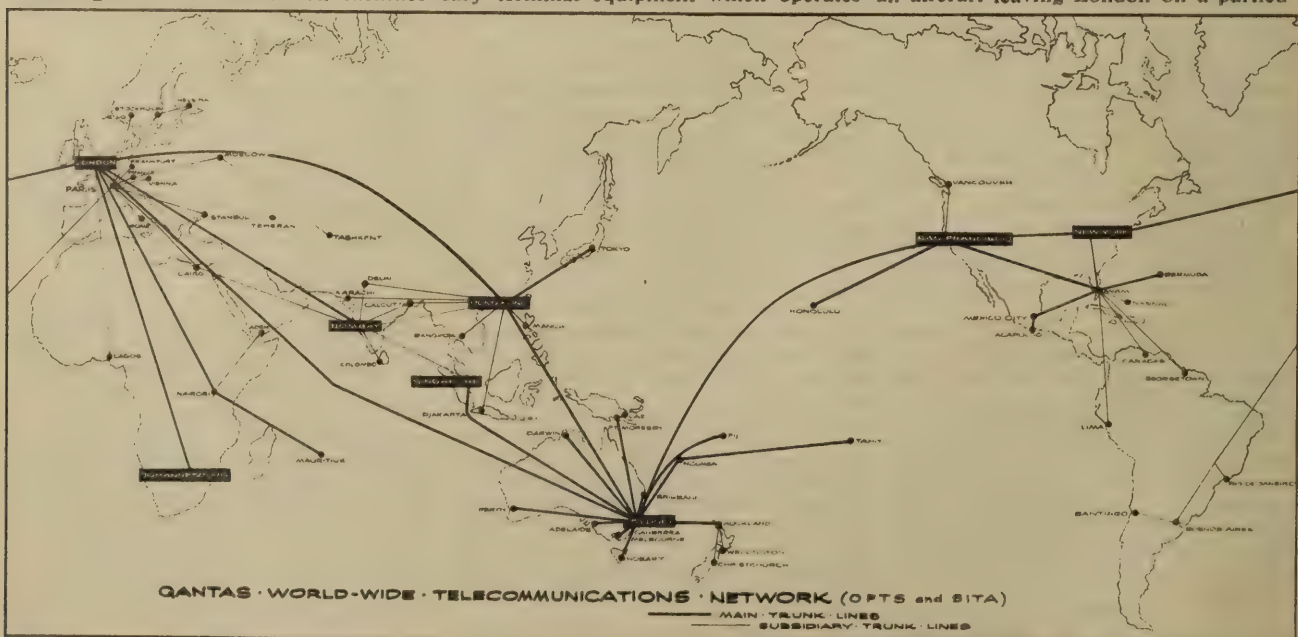
Qantas leases circuits which connect Sydney direct with London, Auckland, Singapore, Nandi (Fiji), San Francisco, Hong Kong and Colombo. Within Australia direct lines connect to Brisbane, Melbourne, D.C.A. Mascot, Qantas Mascot, Qantas House, A.N.A., T.A.A., Air-India and B.O.A.C. Telex facilities link the system to most other destinations.

Telex is a P.M.G. teletype system. Subscribers are provided with the necessary terminal equipment which operates

in conjunction with a central exchange system. Any Telex subscriber can ask to be connected to any other Telex subscriber, using trunk lines if necessary. The caller is charged on a time/distance basis as for a telephone call. The exchange is manually operated at present, but will shortly be converted to automatic. The system can be used internationally but, because of the high cost, it is so used by the airlines only when no other channel is available or when the message is highly confidential.

The Reservations Control Centre in Sydney controls reservations on flights out of Australia for Qantas, B.O.A.C., S.A.A. and Air New Zealand. Incoming flights are controlled mainly from the distant terminal point. For example, the B.O.A.C. centre in London controls incoming flights on the Kangaroo Route (London-Sydney via Middle East) and flights from San Francisco to Sydney are controlled by the Qantas Centre in San Francisco.

If a prospective traveller to London, irrespective of how he intends to travel there; wishes to book a return flight on an aircraft leaving London on a particu-



The cost to the airline company of the leased teletype circuits seems very great at first reading. For instance, the teletype circuits with Singapore involve a payment of £47,000 (\$A94,000) per annum to The Overseas Telecommunications Commission and its counterpart in Singapore. The same amount is paid for the Hong Kong and Colombo circuits. These are for 60 words per minute circuits. Other annual payments to O.T.C. for leases are as follows: San Francisco and London via COMPAC, £56,250; Auckland, £28,000; Nandi, £16,667; Melbourne and Brisbane land line £7,500 each.

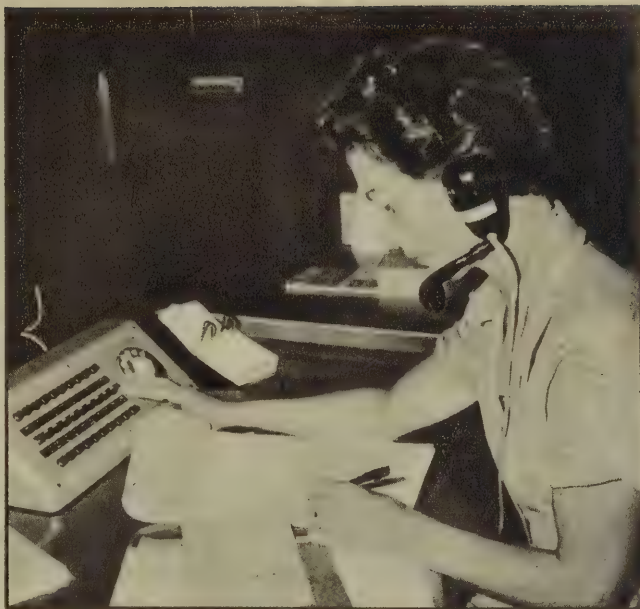
When one first walks into the Seat Reservation section one is immediately impressed with the orderliness which prevails. Row upon row of desks are each manned by a Telephone Sales Operator who attends to a special telephone. There are facilities for handling 40 incoming calls at the one time. Conveyor belts operate between desks to carry messages. A revolving filing system contains passenger itinerary details in date of departure order. All this is part of an overall pattern which ultimately falls neatly into place.

If seats on that flight are unavailable the flight is said to be not open for sale, and the bookings may be put on a "request" or "wait list" status. This means that they are held pending a cancellation or transfer to another flight. Reports from other offices covering sales, requests, cancellations, wait lists, etc., come by teletype to the Sydney office where the flight records are entered and updated manually.

Let us follow a message through the procedure from the request for the seat by a passenger to the transmission of the message. The example is for a seat sought by one Walters on a flight from Nandi to Sydney on Flight QF 587 on 23rd July. I made a request that I would be travelling from Nandi to Sydney on that date and would require a first class seat.

The reservations officer made out a the telecommunications room it is taken

A copy of the docket goes to the Communications Room, where it is punched into tape for teletype transmission to the appropriate office, San Francisco in this case. (Abbreviated "SFO.").



First point of contact for the prospective traveller is one of the many Telephone Sales Positions. Each operator has a switchboard giving rapid access to other reservation personnel.

No.		FAMILY NAME (13)										P/C		TITLE(S)/ADR(S)		PAR CAT.		CORRES. No.		FILE							
1		WALTERS																ABC 1517		JONES							
NAME (CONT)																BKD. BY/DATE		XYZ AGENCY		TEL 12345							
SIGNATURE		[Signature]																		(HOME)							
TO		M.I.										FLIGHT (5)		CL		DATE (5)		FROM (3)		TO (3)		ACTION (2)		NO			
QM QG QD		[Handwritten]										QF587		F		22JUL		NAN		SND		1SS		2		3	
SFCRST												SUPP. (48)															
QM QG QD												ARR		QF586F		22JUL		BOS		YD							
												SUPP. (48)															

Assuming the flight is "open," the operator makes out a docket—in triplicate—containing all the information necessary to complete the booking.

card in triplicate, which is reproduced here. The various numbers and abbreviations are similar to those used in the teletype message to place the booking, and are explained in detail a little further on.

The completed card and its copies are placed on conveyor belts. One copy is carried to the telecommunications centre in an adjoining room. This room has the appearance of a section of the telegraph office at the Sydney G.P.O. Girls sit at teletype machines in one section, perforated tape machines are located in another, whilst a number of tape transmitters occupy yet another. In one corner is all the relay and electronic control apparatus for the machines.

When the reservations card reaches the telecommunications room it is taken

by a teletype operator who prepares it for transmission by typing it on a teletype machine. This machine produces a page copy at the machine and a perforated tape at the tape reception location simultaneously. The tape is punched in the international 5 unit teletype code.

The "tape reception location" is a vital part of the Communications Centre. It is a form of exchange, to which are directed all messages for retransmission to their ultimate destination. It consists of banks of tape punching machines which receive messages from overseas, from interstate or, as we have just noted, from another operator on the other side of the room.

Thus, a message may come in from San Francisco, for redirection to another office in the same building, where it will ultimately be displayed as a printed page. Alternately, a message may come in from Melbourne or Brisbane to be redirected to London. Or, again, a mes-

B - SFO

Q1 SFORROF Q2 SYDRROF

SYDOF

194

150150K

230715K

WALTERS $\leq$ $\leq$ QF

F

JULIAN SYDSS

ARROF

F

JUL BDSYD<

JS <

NNNN

587

23

586

22

二



The Flight Information Section of the reservations system. This section continually updates the flight status as bookings are confirmed, and issues flight status bulletins to Telephone Sales Operators.



The Communications Centre showing, left, tape preparation machines, centre, tape transmitters and, right, the receiving location. A receiving operator is shown feeding a tape into the back of a transmitter rack. It will be withdrawn by the transmitter operator and fed to the appropriate transmitter.

sage may be originated on the other side of the room for ultimate transmission to Hong Kong or Singapore.

It is uncanny to watch messages being punched into tape by machines which are operated by someone thousands of miles away, in London or one of the other world centres. As a matter of interest the Sydney to London circuit travels by COMPAC cable to Vancouver thence by microwave link across Canada to Montreal, thence by CANTAT cable into London. COMPAC and CANTAT cables are the same type. COMPAC means communications across the Pacific. CANTAT means cable across the Atlantic.

The specimen of tape reproduced here, representing the author's booking from Nandi to Sydney, is typical of those which present themselves to the officer at the tape reception location. It contains punched holes representing the message, plus a printed version. The latter has a number of advantages, one of the main ones being to enable the officer to quickly determine the message destination and thus carry out the next

operation.

The message on our specimen tape is as follows:—B 194 (operator at position "B," message number 194 for the day). SFO (San Francisco) QU (Urgent priority) SFORRQF (San Francisco Reservations General Qantas) SYDRRQF (office of origin—Sydney Reservations General Qantas) 150150 (date and time of message, 15th—of the current month—0150GMT. SYDQF 23071 (Sydney Qantas file number). 1 WALTERS QF587 (Qantas-flight-587) F (First class) 23 JULNANSYDSS1 (23 July, Nandi to Sydney, sold one seat) ARROF 586 F 22 JULBDSYD (arriving Nandi Qantas 586 22 July, boarding Sydney flight). JS (operator's initials).

The tape reception operator logs the circuit number of the prepared message on an inwards check sheet, tears off the tape and places it in a transmitting rack in the correct order of priority. The transmitting racks consist of banks of slotted holders of various colours suspended in front of the tape transmitting machines. Each colour represents a certain priority and the tape is inserted

into the appropriate slot by the operator.

The transmitting operator now takes the tape, inserts it into the transmitting head of one of the six transmitters, records the number on a checksheet, presses a button and the message is on its way to its destination with an automatically inserted number preceding it. Messages received from other stations are treated in exactly the same way. The tape is torn off and retransmitted to its final destination after being placed in the racks as outlined above.

Any message addressed to Sydney may be for either the city area or various locations in the Mascot Airport area. These are directed to their destinations by the tape reception operators who, by the addresses and text content, split them into three groups, Mascot Traffic, Mascot Operations/Supplies/Engineering/Catering, and Qantas House. As these messages are transmitted to their destinations they also appear on a page copy monitor from which the distribution staff make further copies when required, redirect to extra locations when required, or take any other action necessary.

After normal office hours, addressees are phoned at home with any messages that may require immediate action. Replies are taken down directly on a typewriter then placed in a message tape preparation position for processing. The office is, however, staffed 24 hours a day for the reception of messages and reservation from other parts of the world.

Messages from keypoints in the Mascot Airport area are transmitted to the Telecommunications Centre per medium of the MUFAX facsimile transmitter. This operates on a similar principle to a picture transmitting machine. The message is printed manually or typed on a form. This is inserted into the transmitter which is connected by landline to a receiver at the Telcom centre. An exact copy of the form with its message is reproduced on this receiver.

There are two main problems associated with the present system of seat reservation. Firstly there is the slowness with which bookings or cancellations are incorporated into the reservations control system and secondly the problem of physically handling and storing vast amounts of paper work. Dealing with about 300,000 passengers a year generates a lot of message handling. In one month of this year 230,440 such messages were processed by Qantas.

Manual handling of such traffic will become almost completely impractical if continued for much longer. The whole system will break down under masses of paper work. At the present time messages may take from a few minutes to a few hours to forward depending on the rate of flow of messages into the centre. At present the peak load rate of forwarding is about 1,000 messages per hour, which is still not fast enough to cope with the tremendous growth of passenger traffic.

The obvious solution to these problems is some form of automatic message handling and reservation system, involving computers. Such a system should be able to perform, electronically, most of the message handling and reservation functions which are now performed manually. Such a system is being adopted by Qantas with the introduction of their Qantam Computerised Communications and Reservation System. This will be described in Part 2 of this article next month. ■

KEF SPEAKERS

The complete range of KEF speakers is now in stock. Our shipment includes the new model "Celeste" which incorporates the new super-tweeter. This KEF tweeter offers considerable improvement in HF performance. Ask for our KEF prices... just specify the model of interest to you. Use our speedy mail quote service!

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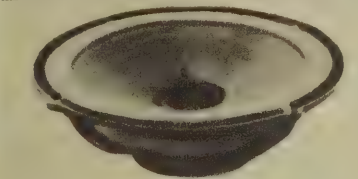
Now in stock... the NEW OKI FT2020 fully transistorised stereo recorder, the Tandberg Model 6 and 74B, the recently arrived BRENELL and also the new REVOK Model G36. Write to us for a price... our agreements with the agents forbid advertising prices. These are the world's leading makes, and are used in studios all over the globe.

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Model W14 fully transistorised stereo amp. **£84/10/-**



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The Mk II Kelly Ribbon Tweeter is well known and deserves its universal reputation. The Mk II is the most effective domestic treble unit to come to the Australian market, regardless of price. The perfect partner for the Mk III bass unit. Crossover to match: **£4/10/-**.

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Celestion

Celestion speakers are internationally acclaimed and are used by professional studios all over the world. Both models feature co-axial treble and bass units with electrical crossovers at 4 kc/s. These advanced speakers are worthy of the most effective high fidelity amplifying system. Read the reviews in the April "Gramophone" (Page 511) and June "Hi-Fi News" (Page 73). The standard Model CX-1512 is rated at 15 watts RMS.

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The De Luxe Model CX2012 is rated at 20 watts RMS.

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Without doubt, this compact (12 1/4 in x 6 3/4 in x 8 1/4 in) speaker system is the most advanced 10 watt high fidelity speaker system available in the world. Frequency response is 35-15,000 c/s. Available in Walnut and Teak finishes. (See review, Page 41, June "Gramophone") **£29/10/-**

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1 Labcraft 643 turntable with B. and O. stereo diamond cartridge, two 10 in Wharfedale RS/DD speakers **£42**

2 SANSUI SM34 stereophonic amplifier complete with AM/AM/FM/SW tuners, J.H. turntable, J.H. tone arm, ADC 660 cartridge (diamond), two Goodmans or two Celestion 12 in wide range speakers. **£169**

3 Labcraft turntable with diamond stylus, 10 watts per channel stereo amplifier, two Wharfedale 8 in RS/DD Speakers. Best value ever **£55**

4 Labcraft 605 turntable, Pritchard tone arm with ADC stereo diamond cartridge. (If you would prefer an Orpheus Silex turntable, simply add £8). **£39/15**

5 Pioneer SMB 161 stereo amplifier with AM/AM/SW tuners, Labcraft 643 turntable, B. and O. stereo diamond magnetic cartridge, two 8 in RS/DD Wharfedale speakers. **£89**
With the Labcraft 605 turntable, All-Balance tone arm and ADC 770 cartridge **£99/10/-**

6 Pioneer 204 B stereo amplifier with AM/AM/SW tuners or Pioneer SM83 (no tuners), two Celestion 12 in CX1512 co-axial speakers. (Ask for a price with any other speakers.) **£109/15**

7 The well-known Star SA30 or the new Encel X1212 stereo amplifier, Labcraft 605 turntable, J.H. tone arm, ADC 770 stereo diamond cartridge, two twin cone 10" Wharfedale RS/DD speakers. (If you prefer them, Richard Allen 10" or Stentorians) **£94/10**
List price, £132

8 Leak "Stereo 30" solid state stereo amplifier OR Leak "Varislope" pre-amp with "Stereo 20" power amplifier, two Goodmans Tri-axiom 212 wide range speakers **£159/10**
a magnificent combination (Ask for an estimate with other speakers of your choice...)

EARLY ENCEL SPECIALS STILL AVAILABLE

The Special offers made from time to time by Encel Electronics in "Electronics Australia" (Page 15) are kept open for several months. In the majority of cases, the prices quoted are still applicable. Please check with us!

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COMPUTER SYSTEM TO STRENGTHEN U.S. AIR DEFENCES

Data display consoles allow defence commanders to "talk" to computers in the BUIC (Back Up Interceptor Control) system. The TV-like consoles present information such as the location of approaching aircraft and status of retaliatory forces. The commander can direct an impending air battle by placing a light pen on the face of the display, causing the computer to issue instant commands.

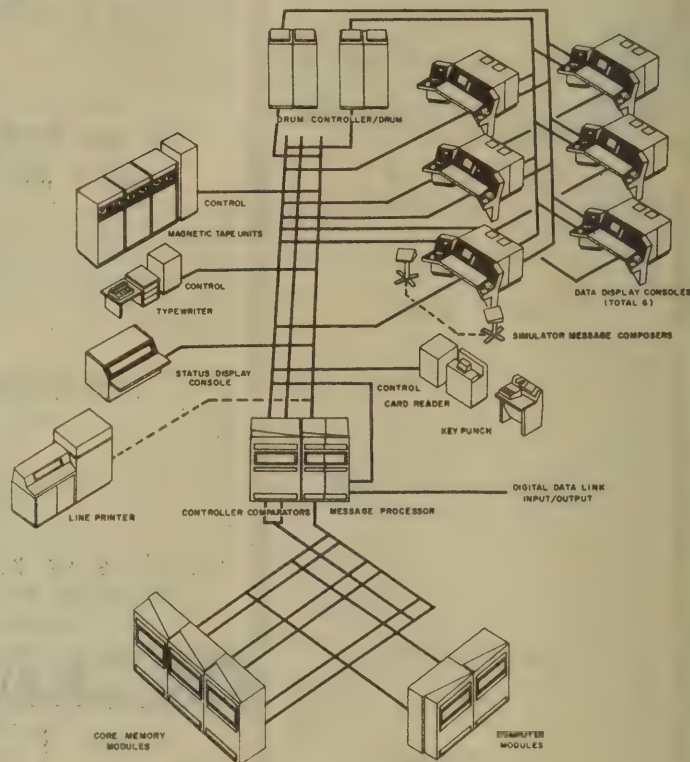
THE United States defences were strengthened as the first unit of a new electronic continental air defence system became operational on September 1, at North Truro (Cape Cod), Massachusetts. The system known as BUIC (Back Up Interceptor Control) will soon be located at many sites to provide defence if units of the existing SAGE air defence system should become inoperative.

Serving as the prime equipment contractor to the Air Force Systems Command's Electronic Systems Division, Burroughs designed and produced the high-speed electronic computers and data displays which provide BUIC air defence commanders with the ability to detect and track enemy aircraft and direct the air battle.

The D825 computer at each BUIC site automatically analyses data from long-range radars concerning the location of all aircraft in the area. The computer also accepts inputs relating to aircraft flight plans, as well as weather, status of retaliatory forces (manned interceptors and Bomarc or Nike missiles) and data from adjacent BUIC sites. TV-like display consoles serve as the vital man-machine link by which information is obtained from the computer.

Target data is processed by the computer and appears on the display along with other combat information to aid the BUIC commander in directing and controlling his forces. The commander determines what action should be taken and uses the con-

A block diagram of the radar course directing group for the BUIC system. It will take over control of air defences if the existing SAGE (Semi Automatic Ground Environment) air defence system should become inoperative for any reason.



Burroughs engineers check out the D825 Data Processing System prior to its delivery to the U.S. Air Force at North Truro, Mass., for use in the Back Up Interceptor Control System. The system employs solid-state circuitry, has a reserve against possible faults and can be expanded to meet future requirements.

soles to enter his decision into the computer. Automation takes over as the computer calculates the proper mid-air intercept point and generates signals which guide the fighters or missiles as they streak to the target.

The D825 system is specifically designed for "multiprocessing" — the simultaneous processing of different air defence problems at the same time — and is made up of a series of functionally independent modules which allow the system to continue operating even if failure should occur. In the current SAGE defence system this is accomplished by complete duplication of equipment.

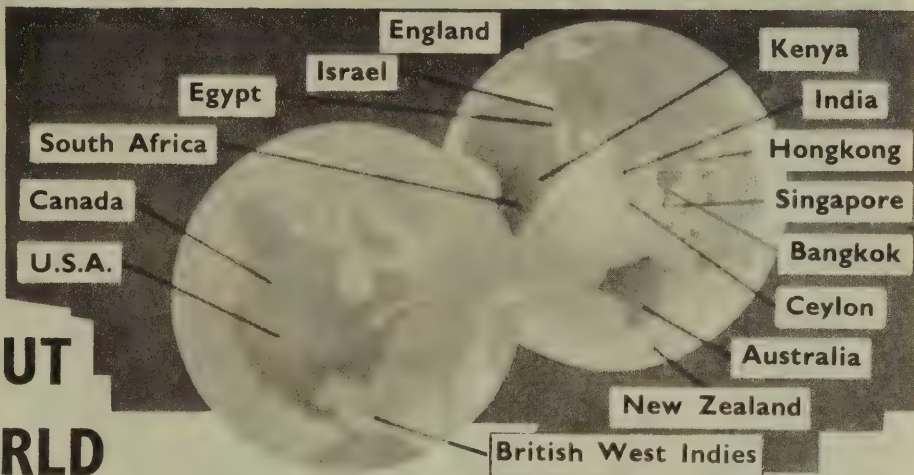
The D825 for BUIC allows the same reliability to be achieved with only partial duplication. Only one additional module of each type need be added. For instance, if five memory modules are needed for data storage, six are included in the system.

The result is a tremendous cost saving while a greater degree of reliability is achieved through use of fewer parts and transistorised circuits. In addition, the modular nature of the system allows it to grow to meet new requirements as they occur.

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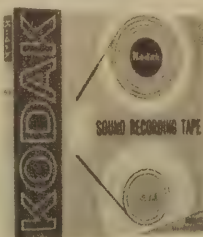


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up on recorder heads, as well as suppressing noise.

To cut friction still more, we use a special lubricant both in the magnetic layer and on the base.

This double dose has several desirable effects: the tape glides freely over recorder heads, prolonging their life; there's no slippage over capstans, so constant speed is assured; the lubricant is chemically stable — it does not smear on your equipment.

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KM1052

Backgrounds can now be projected from the front

A system of composite photography has been developed to provide a simple and economic means of photographing subjects so that they appear as a natural part of a background image.

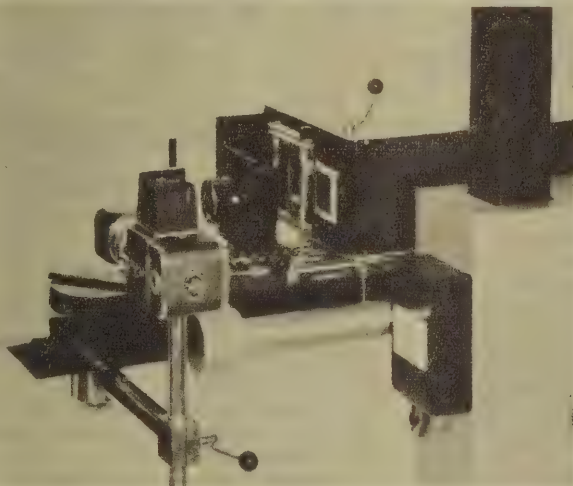
PHOTOGRAPHS can be taken with backgrounds and poses which could only be otherwise obtained by using a lot of "props" or by sending models, clothing, photographers and their equipment on expensive long trips to get the right atmosphere.

Unlike conventional schemes, which employ back projection on to a translucent screen, this is a front-projection device, with the camera, projector and subject all placed on the same side of the screen. This makes the system suitable for the smaller studio.

One of its important features is a special screen which has a surface composed of millions of microscopic beads which have the ability to reflect light within an extremely



Leo Vala discusses composition with a model, who may later be pictured standing talking to the Arab on the camel. They are seated on the reflecting grille which extends the screen horizontally to provide a simulated foreground.



The projector and lighting control box (right) showing the lever which brings the electronic flash equipment into use. Note the half-silvered mirror between the projector lens and the camera lens. The box on the left is a "light box" which catches any light coming through the half-silvered mirror from the projector and disperses it.

narrow angle, back to the original light source. Under ordinary daylight, the screen is a dull grey colour; when fully illuminated it appears black from any other position except from the point of the light source. If a picture is projected on to the screen and viewed from the axis of the projector—which is the same as the camera lens—the picture is of phenomenal brilliance.

The base of the screen is extended forward by means of a series of mounted strips of the screen material to form a platform on which the model stands.

A live model, for example, can be made to appear as though he were leaning against a post, which is, in fact, only a projected image on the screen a foot or two behind him. Adjustment of the image puts the post "before," "beside," or "behind" the model. Many variations are possible.

To allow the projector and camera lens to operate from the same "view-point," the projector lens is placed at right angles to the camera lens, with a semi-silvered mirror between them at an angle of 45 degrees; thus the projected transparency is reflected on the background screen while the camera lens

can see through the mirror on the same axis.

The projector box also contains the control equipment for floodlighting and measures the electronic flash required. Movement of a small lever on the control box puts out the lights and brings the electronic flash circuit in, ready for synchronised operation with the camera shutter.

The system can be used for black and white, colour photography, and for "still" or "movie" camera shots.

Under the trade name "Transflex," the system is patented in Britain and 12 major countries, the patents being held jointly by The Rank Organisation and two French engineers Alekan and Garrard.

The system is being marketed by Rank Studio Equipment, who have been assisted in its development and practical application by Leo Vala, a well-known Knightsbridge (London) studio photographer. ■

25in. TV RECEIVERS FOR SCHOOLS

THE latest type of 25-inch receivers, specially developed for viewing television sessions organised by the Australian Broadcasting Commission and the Department of Education, have been ordered by the Department for secondary schools in New South Wales.

The order has been placed with Amalgamated Wireless (Australasia) Limited whose 23-inch television receivers are already operating in about 160 departmental secondary schools in the Sydney metropolitan area and the country for viewing mathematics and science programs.

The receiver is mounted on a wheel-about frame designed so that the centre of the picture is 5 feet from the floor and the picture is tilted downwards towards the class for improved viewing. The same company has installed receivers in 100 non-departmental schools which receive the educational programs.

The N.S.W. Department of Education is again subsidising 20 per cent of the cost of receivers for departmental secondary schools. ■

NO! IT ISN'T BLACK MAGIC



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Pipe and Cable Finder

WITH BUILT-IN LOUDSPEAKER

FIBREGLOSS CABINETS

Receiver and transmitter clamp together to form compact carrying case. Note modern appearance of the sleek Fibreglass cabinets.

"Electronic Witchcraft" that ferrets out those pipes although they are in the ground, in walls or in floors.

And it's so convenient to use — It provides a good, clear signal from the built-in loudspeaker which can be heard at distances up to 50 feet or more. However — conventional ear-phones may be used if desired.



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- DEPTH MEASUREMENT
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- LOCATING JUNCTIONS
- RESOLVING PIPE OR CABLE NETWORKS
- FINDING CLAY DRAINS (if metallic conductor can be inserted)

SPECIFICATIONS

Transistors, 6 in receiver, 3 in transmitter, hermetically sealed.

Printed circuits, single turn solid metal low impedance loops, and 3 sharply tuned circuits for interference prevention with maximum efficiency.

Unbreakable Fibreglass cases.

Power selection including new Super Power control.

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Built-In Pulsator.

Built-In Battery testers.

Multi-Directional depth level.

Batteries: Two small standard low voltage batteries.

Weight: Receiver 5 lbs., Transmitter 5 lbs.

Accessories: Shipped complete and ready to operate with batteries, unbreakable aluminium carrying handle, detachable belt for drop handle operation, conductive cable and ground plate, instructions.

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Technical Review

MINIATURE INDUCTORS FOR INTEGRATED CIRCUITS

Of all the components which engineers have attempted to minaturise in recent years, the inductor has been the least amenable, and designers have acquired the habit of avoiding this component wherever possible. Later attempts to shrink these components have been more successful, and this article from a recent issue of "Electronics" gives a good idea of what is being achieved.

By Steven Slenker*

INDUCTORS, transformers and chokes are no longer the missing links in the chain of small components available for integrated circuits. Right now, tunable inductors not much larger than transistor dice are available for use in hybrid circuit design.

Many designers, believing that such small units could not be made, have kept inductors out of integrated circuits. They have constructed elaborate circuits with as many as 20 components to do the job of a simple inductor. These circuits often have poorer electrical characteristics than an equivalent inductor.

Miniature inductors can replace their much larger counterparts in about 80 per cent of all circuit applications. They generally permit circuit reductions of 20 per cent to 80 per cent; the devices themselves are only 1/1,000th the size of the smallest adjustable inductors previously made. Tunable inductors with Q's of 50 and values of 100 microhenries have been made 0.070in in diameter and 0.155in long. Their most widespread application is in RF and IF amplifiers that operate between megacycle and 1 gigacycle. Inductors tunable over a range of 5 to 7 nanohenries are being used in stripline amplifiers. Series chokes are being used in 2GC amplifiers.

Low stray capacitance, wide tuning range, and high stability permit their use in microwave applications. In certain microwave circuits, microelectronic inductors achieve stabilities of ± 8 ppm per degree centigrade.

Designers of miniature components have taken several approaches to make inductors for integrated circuits.

Thin-film inductors have proved unsatisfactory because of their low values of inductance and low Qs. Integrated R-C networks with resonant characteristics have had poor stability and poor

Mechanically resonant filters, such as

piezoelectric and magnetostrictive devices, have extremely high Qs, but generally cannot be adjusted for the resonant frequency, and for Q.

Some designers have combined small inductors which have low Q's with high gain integrated feedback networks to produce active tuned circuits whose performance is equivalent to or superior to that of circuits using conventional inductors. Electrical characteristics of inductors have been improved by using circuits that multiply Q.

The problem of miniaturising inductors lies in reducing the size of the device without reducing the permeability of the magnetic core. Permeability is a measure of how much a given material will enhance a magnetic field; it is given by the ratio of magnetic induction to magnetising force.

An inductor consists of several turns of wire around a core of magnetic material. This material has built-in magnetic fields, which can be thought of as tiny magnetic dipoles. Current passing through the wire can be pictured as a sheet of current flowing around the core. To store energy in the material, the magnetic dipoles must be easily orientated by the current flowing through the wire, and must not exhibit a great loss of orientation.

The particles of core material may be held together by a binder—epoxy for powdered iron, ceramic for ferrite ores. The binder is necessary to insulate the conductive particles from each other, so as to prevent the flow of eddy currents within the core, which reduce the magnetic field and lower the Q.

The permeability of the core is dependent upon the type of binder used, the core material and the ease with which the magnetic dipoles can be orientated, and the time it takes for the dipoles to change from one magnetic orientation to another.

The Q of an inductor may be defined as the ratio of the energy stored to the energy dissipated per cycle. The energy stored is in the form of the magnetic field; if a high permeability

core is used, reducing the size of the core may not affect the permeability of the over-all device.

Size reduction means using finer wire, which need not lower the Q of the inductor. Q may be maintained or even increased in some cases, if the effective permeability of the magnetic material can be increased. This can be accomplished by an extremely simple technique.

If the wire—and thus the effective sheet current—is brought closer to the core, then the air gap between the current sheet and core is reduced. A greater portion of the medium inside the inductor can be filled with magnetic material, and the permeability of the medium with a smaller air gap will be increased.

This is the key to reducing the size of inductors: reduce the air gap and increase the average internal permeability of the core.

When the size of the inductor is reduced, it is possible to obtain almost the same inductance and Q by increasing the sheet current density (by increasing the number of turns of wire), and obtaining better orientation of the magnetic particles in the core. The only parameter sacrificed is power rating. But in microelectronics, less power handling capacity is required. Standard inductors are usually operated at a small fraction of their available power handling capacity.

The properties of magnetic materials have not been analysed to prove the absolute limits of field enhancement that can be obtained. It is reasonable to expect that improved magnetic materials will permit even further size reductions of inductors, and will possibly improve electrical characteristics.

Standard fixed inductors and transformers now available are 0.075in in diameter and 0.175in long, tunable units are 0.325 to 0.475in long and 0.095in in diameter. The smallest inductors made to date have cores that are 0.012 to 0.130in in diameter, and 0.030 to 0.150in long. The Qs of the smallest range from 7 to 25 in values to 5 microhenries. The problem of actually constructing such small devices lies in production techniques for making small cores, winding wire around the core, threading cores and plastics to accuracies better than one ten thousandths of an inch, and moulding devices to the same tolerances.

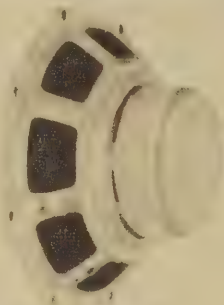
(Continued on page 23)

*President, Piconics, North Billerica, Mass., U.S.A.

MASTER RANGE



Philips Hi-Fidelity loudspeakers



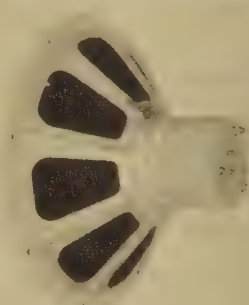
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PROTECT EXCAVATION WORKERS

The safety of any engineering structure, and the workers employed on it, depends very largely on the pressures exerted on it from various sources. Pressure sensitive cells, which may be mounted at any desired point and monitored at a central console, are the latest answer to this vital problem.

By James W. Essex

IN a city in south-western Ontario, a sewage project called for constructing a foundation 25 feet below the mean water level of an adjacent river, and about 10 feet from the closest building. The base soil was dense, fine sand and there was certain danger of huge earth movements. The scheme couldn't have been adopted, if it hadn't been for pressure cells.

Undertaken jointly by the Civil Engineering Departments of McMaster University in Hamilton, the University of Waterloo, and the National Research Council in Ottawa, who made the equipment available, the job was begun late in 1963. The electronic equipment used on the job, though it offers nothing new in the way of circuitry, is an ingenious application of known techniques.

A cofferdam (a watertight enclosure) of steel sheet-pilings was sunk into the ground, forming a square surrounding the area to be excavated. These piles stand about 50 feet high and are interlocked, one into another, forming a wall of steel.

At spots on the face of the wall pressure cells are mounted. The cells are individually connected to a control box, which allows any one of 13 cells to be checked in turn, through a master cable to a metal cabinet which contains simply an amplifier, crystal and variable oscillators, a cathode-ray tube and a power supply.

The function of the device is to display changes in pressure at the cell faces by a pattern on the CR tube. With information gained from the pressure cells, engineers can judge the adequacy of the "I" beams placed on layers within the cofferdam to shore up the walls and restrain the earth which otherwise would cave in. Excavation is carried on by buckets lowered between the squares formed by the "I" beams.

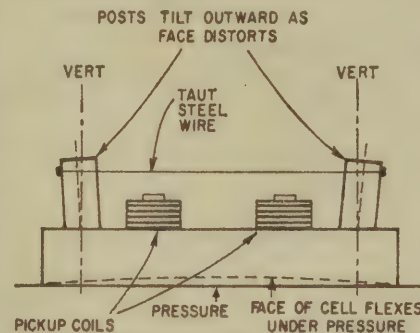
The pickup head of the pressure cell works like a magnetic audio pickup, except that there is no needle to excite the magnetic field and induce an AC signal in the pickup coil. Rather, there's a taut steel wire (figure 1), set vibrating by a pulse sent out by a discharge tube in the control unit. The pressure cell is something like an ordinary magnetic earphone, and uses a similar dual coil magnet. However, in place of the normal diaphragm is the taut steel wire, .01 inch diameter, supported between two posts on the cover of the unit.

This cover, when in place, allows the steel string to almost touch the pole pieces. Only a slight air gap separates it from them. A pulse from the control box "twangs" the wires. The pulse rate applied to the head can be varied.

There's sufficient pause after each

voltage kick for the steel string to vibrate at the frequency determined by its tension. This is around 1,000 cycles normally. As pressure is applied to the face of the cell, bending it very slightly but enough to spread the posts, the string is tightened and its resonant frequency rises.

The control unit has facilities for comparing a variable oscillator frequency with a standard 1,000 cycles developed by a crystal. This operation establishes the reference frequency and



The pressure sensitive cell. Pressure is translated to tension on the steel wire and read as the wire's resonant frequency.

is noted by settings on a calibrated dial. The frequency of each cell in the laboratory during initial setup is noted on a chart. Because of the cells' construction they vary slightly (no one can tighten the steel string to a hair-splitting accuracy). Therefore, each cell is calibrated. The frequency is noted for zero pressure on the face. Then, as pressure is increased, the frequency goes up, and this is plotted on a graph.

When the outgoing signal and the bounced-back signal from the cell are the same, the scope, set up to display a Lissajous pattern, shows a circle. To maintain this circle as the pressure on the cell (and its frequency) increase, the local oscillator must be adjusted accordingly. By reading the calibrated dial, a plot of pressure versus frequency can be prepared for each cell.

The number of pressure cells this unit can handle is limited only by the "switchboard" capacity ahead of the display unit and the money to invest in the cells. A good operator can monitor them continuously, reporting any sudden deviations in pressure in time to avert what might be a disaster.

The project described represents only the second in Canada (both in Ontario), the other having been done by N.R.C. in Ottawa. This indicates the experimental nature of the project. It is understood that the Norwegians, who designed this type of unit originally, use it extensively.

The author acknowledges with thanks the help extended by Professor N. Wilson, McMaster University, and Professors Don Scott, Carl Christensen and P. Finn, of the University of Waterloo.

("Radio-Electronics," August, 1965) ■

MINIATURE INDUCTORS—continued

Most large inductors used for IF amplifiers have a Q of about 40 and values of inductance from 1 to 15 microhenries. Small devices have exactly the same electrical characteristics, except for slight reduction in Q—to 25 or 35. However, when placed in a circuit loaded by transistor impedance, this difference is generally undetectable. For all practical purposes, the small inductor does the same job as its larger counterpart. Reduction in size often enhances performance characteristics, rather than degrading them.

The tuning range of adjustable units depends upon the value of inductance, and the core material. Generally, a tuning range of 2 to 1 can be provided. A tuning range 5 to 1 can be achieved in devices that have large values of inductance; for example, a single inductor will tune from one millihenry to five millihenries. Generally, microelement inductors can attain higher frequencies than conventional units.

In circuits where the inductor is loaded by a transistor, transistor impedance is so low that the Q of the inductor can be varied over a wide range without measurable circuit gain or bandwidth changes.

Microelectronic devices have lower stray capacitance than conventional devices because of a smaller surface area of wire. The effective dielectric thickness is not reduced proportionally.

The stability of the miniature inductor is the same as a conventional inductor operating in identical circumstances. Inductors can be made in microcircuit sizes with temperature coefficients in the range of ± 15 ppm to ± 300 ppm per degree centigrade.

The tiny inductors do not have large magnetic fields and can be placed very close together without causing parasitic generation or circuit oscillation. Two inductors can generally be placed close together, with their magnetic fields orientated for positive feedback, without causing oscillation. In a 20dB gain stage, they can be as close together as four times the diameter of the inductor cores, measured between coil axes and produce less than 1dB of gain change. This space shielding is extremely effective for high-density packaging, and eliminates the need for shielding hardware in most cases. Metal tuning tools or hand capacitance have no detuning effects on the devices.

("Electronics" Vol. 38 No. 11) ■

NEW SILICON TRANSISTORS FROM Mullard



A new range of silicon planar transistors is now available from Mullard with a wide application in the entertainment, industrial and professional fields.

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Type Number	Description	V_{CBO} (V)	V_{EBO} (V)	I_C (mA)	P_{tot} (mW)	f_T (Mc/s)	h_{FE}
BF115	n-p-n RF silicon planar epitaxial transistor	50	5	30	140	230	45 to 165
BC107	n-p-n AF silicon planar epitaxial transistor	45	5	50	300	85	125 to 500
BC108	n-p-n AF silicon planar epitaxial transistor	20	5	50	300	85	125 to 500
BC109	n-p-n low-noise AF silicon planar epitaxial transistor	20	5	50	300	95	240 to 900

Mullard silicon planar transistors are designed so that each gives optimum performance for a particular application, such as RF or AF amplifiers. The BF115, for example, is designed as an AGC controlled RF amplifier, its low value of feedback capacitance providing high gain; and low knee voltage (less than 1V at 10mA) enabling a large voltage swing to be achieved in IF stages.

More detailed information on these transistors may be obtained from the Mullard Technical Service Departments at the addresses below.

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SCIENTIFIC AND INDUSTRIAL NEWS

Cryogenic Calibrator

A cryogenic calibration dewar, originally designed for thermometer calibration systems, is available from Union Carbide Corporation. Known as the CD-77, the unit employs liquid hydrogen in combination with electric heating to provide a precisely controlled temperature environment from 17 degrees K to 300 degrees K.

The central chamber of the dewar is filled with helium gas which serves as a heat exchange medium. The components being calibrated are mounted in a copper block suspended within the helium-filled chamber. Temperature control is effected by balancing an electric heater mounted on the copper block against the cooling from the surrounding liquid hydrogen jacket. The entire unit is housed in a specially constructed cryogenic container which incorporates Union Carbide Super-Insulation for maximum thermal efficiency. (Union Carbide International Company, Division of Union Carbide Corporation, 270 Park Avenue, New York, U.S.A., 10017.)

New Flying School

A new flying training organisation has begun operations at Hoxton Park, west of Liverpool near Sydney. Known as Hoxton Park Flying School Pty. Ltd., the company is a joint venture between Hawker De Havilland Australia and Illawarra Flying School. Initially the school is equipped with two Victa 115 aircraft but the number of machines in operation is expected to increase rapidly with the introduction of a variety of more sophisticated types.

Manager of the school and chief flying instructor is ex-R.A.A.F. instructor, Mr John Williams, and the four-man board of directors are all well-established figures in the aviation industry. They are: Mr L. R. Jones, chairman, and a director of Hawker De Havilland; Mr K. J. Robey, managing director, who has had many years' experience in the management of flying schools; Mr R. R. Green, ex-R.A.A.F. Central Flying School instructor and now H.D.H. chief test pilot for both fixed and rotary wing aircraft; and Mr D. R. Fawcett who is managing director of Illawarra Flying School.

Auckland's Bright Light

Reporting in the BBC "Science and Industry" program on new developments in lighting, Denis Desoutter spoke of the new lighthouse in Auckland Harbour, New Zealand, which is using a tube filled with Xenon gas of a design perfected only in the last couple of years. "Made by Associated Electrical Industries, and with special high quality lenses made by Stone Chance Limited, it produces a beam of $9\frac{1}{2}$ million candlepower. Even in daylight, it can be seen at a distance of twenty miles, and at night its reflection is seen over the horizon from over 45-miles away. It is said to be the most powerful maritime lighthouse installed since the war, and was built through the generosity of the late Sir Ernest Davis, a former Lord Mayor of Auckland and a well-known yachtsman."

Spraying in Windy Weather

Paint spraying equipment for use outdoors in windy conditions has been developed by Hursant Electronics of Feltham, Middlesex, England. Most spraying systems are affected by air movement and, in the building industry especially, application of paint by this method can be prevented by breezy weather. However, Hursant's Weather master electrostatic spraygun is claimed to make it possible to apply protective finishes in conditions ranging from a light breeze to a 20-mile-an-hour wind.

When there are crosswinds, there is a slight shift of the spray pattern in the direction of the wind, but the spray pattern is at all times completely under control, it is claimed.

ELECTRONICS Australia, November, 1965

Split-second Switch

Insulating materials are usually tested by applying to them the high voltage output of a testing transformer. Provision is usually made to increase the test voltage gradually up to at least twice the rated voltage of the equipment.

If the insulation fails during a test, it is desirable to stop the resultant electrical discharge quickly to avoid further damage to the insulating materials, as this would make it more difficult to determine the cause of failure. This damage is reduced if a switch is used in the circuit to disconnect the testing transformer automatically as soon as a failure occurs. Conventional electro-mechanical switches operate comparatively slowly.

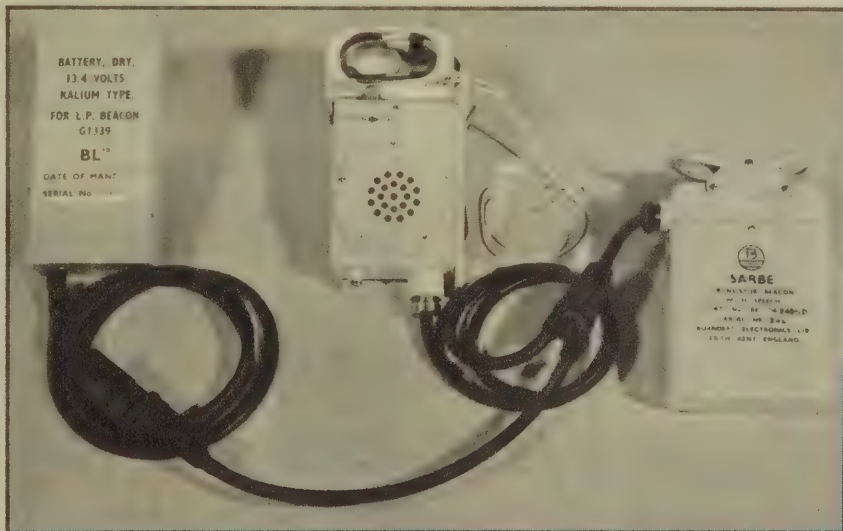
Mr L. Medina, of the CSIRO Division of Applied Physics, University Grounds, Sydney, has developed an electronic switch for use in the Division's high voltage laboratory. This switch opens within a hundredth of a second of insulation failure. It incorporates a silicon controlled rectifier and several other solid-state electronic devices.

An electromechanical switch is liable to break the circuit at an instant when appreciable current is flowing. This causes undesirable high voltage surges. The characteristics of the electronic switch are such that it operates when the current is zero and surges are avoided. The switch can be easily adjusted to trip at a selected value of fault current and, after tripping, can be reset by operating a small toggle switch. It has a rating of 10 amperes, 240 volts, making it suitable for use with small testing transformers up to about 100KV. Faults of short duration up to 100 amperes will not damage it.

Luminous Watches

Draft international safety recommendations to govern the use of radio-luminous paints on dials of watches and clocks have been finalised by an expert conference sponsored by I.A.E.A. and E.N.E.A, the UN and O.E.C.D. atomic organisations.

The recommendations specify maximum activity limits for the three radioactive isotopes (tritium, promethium-147 and radium-226) used in watches and clocks.



RAAF aircrews are to be equipped with the Sabre distress transmitter made by Burndep Electronics Ltd. at Erith, Kent, U.K. The Sabre 310 unit selected by the RAAF weighs 48oz complete with battery, microphone and speech amplifier. Worn in a lifejacket or attached to ejection seats, it sends out a continuous signal on the military international distress frequency of 243MC. To an aircraft at 30,000ft signal range is up to 200 miles, though range on two-way speech is much less. The equipment is widely used throughout the world by military personnel, but is finding increasing civilian application, including private fliers and yachtsmen. (In Australia, D. R. Johnson & Co., "Stanhill 33," Queens Rd., Melbourne, SC2).

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Inductance: 0-10,000H (4 ranges)
GM: 0-20,000 umhos
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RF Volts: 0-1200 rms (4 ranges)
0-3500 p-p (4 ranges)



MODEL FN
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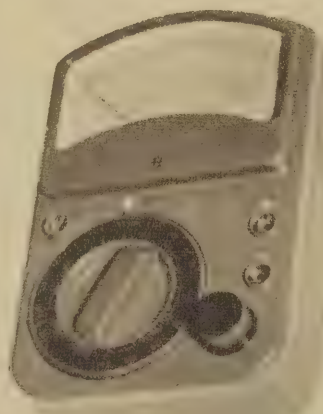
Sensitivity: DC:20,000 opv
AC:5,000 opv.
Volts: DC:0-700 (7 ranges)
AC:0-700 (6 ranges)
Current: DC:0-50uA, 0-7-140mA
Ohms: 0-5-500K: 0-50 Megs.
Capacity: 0-0.03 - 0.6 uF
Inductance: 0-5-500H
Decibels: -20 to +59
RF Volts: 0-14 rms: 0-40 p-p

Sensitivity: DC:20,000 opv.
AC:10,000 opv.
Volts: DC:0-600 (6 ranges)
AC:0-600 (4 ranges)
Current: DC:0-50uA-12mA-300mA
Ohms: 0-10K: 1-10-100 Megs
Capacity: 0-0.03-0.6 uF
Inductance: 0-5000H
Decibels: -15 to +58
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AC:2,700 opv.
Volts DC:0-600 (5 ranges)
AC:0-600 (4 ranges)
Current DC: 0-300uA: 0-12-300mA
Ohms: 0-20K:0-2-200 Megs
Capacity: 0-0-1-0-2uF
Inductance: 0-1000H
Decibels: -15 to +58
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Spray Gun

A British tool for the engineering shop reported recently in the BBC 'New Ideas' program is the latest high temperature spray gun from the firm of F. W. Birk and Co. Limited, of Ealing London.

"This extremely versatile spray gun is designed to spray most powdered materials with a melting point of up to 3,000 degrees centigrade," said reporter Leslie Bell. "This means that it will not only spray ceramics, but also makes it ideal for build-up work using steels and high temperature alloys. Indeed, some of the main characteristics of the coating produced by this gun include high density, and really first-class adhesion and grind properties."

"The equipment consists of three separate units — the gun, the powder feeder and the control cabinet—and is quite free from complicated devices such as air motors. There are, in fact, no moving parts whatsoever in the actual pistol. This makes maintenance extremely easy and cheap, and the equipment is both light to handle and simple to operate. It is unique from an engineering point of view; for it incorporates a specially designed multi-bore nozzle and dual mixer system that allows it to use 75 per cent less air and 20 per cent less gases than conventional powder guns, spraying at lower feed rates."

Radio University

The University of N.S.W. has announced two courses to be presented in the near future over its radio broadcast facilities.

"Computers At Work—Part 1" is the title of a series of six lectures to be broadcast over the Newcastle transmitter at 8 p.m. on Thursday evenings. Enrolment is invited prior to October 1, but later enrolments will be accepted, subject to commencement of the course later in the month. The enrolment fee, covering the cost of essential printed material, is £2/10/.

Over the Sydney transmitter, during November, a course will be broadcast entitled "Semiconductor Applications." The course will be broadcast on Monday evenings at 7 p.m., repeated

at the same time each following Wednesdays. Enrolment is called for by October 8 if possible and the fee, in this case, will be £3.

Details of these and other radio courses are available from Radio University, P.O. Box 1, Kensington, N.S.W.

Mottle-Dyeing Yarns

Continuous mottle-dyeing of yarns and fibres is claimed to be possible in a process developed by Toyo Rayon K. K., of 2-2-chrome, Nihonbashi, Chuo-ku, Tokyo.

The method comprises vibrating the longitudinally running yarn with an electro-magnetic vibrator which brings it into intermittent contact with a roller set at a predetermined distance. The roller is kept impregnated with a dye-paste by a second roller.

Cotton, wool and silk fibres can all be treated in this way, it is stated, whether they are to be knitted or woven. Artificial fibres can also be treated if a stronger dye is used.

Dries Paint Faster

An additive for all types of paint which makes them dry very quickly but avoids wrinkling of the film has been patented by L. J. Volkers, of 104 Minervalaan, Amsterdam, Holland. Composed essentially of complex Cobalt and Xirconium salts in quantities of less than one per cent, the drying agent is stable when exposed to air and easily mixed with paints.

BBC Educational Broadcasting

The BBC began regular broadcasts for British schools in 1924 and, in 1957, introduced regular television schools broadcasts. Today BBC educational broadcasting covers a wide range of programs for adults as well as broadcasts specifically for schools.

Of 37,000 schools in Britain, 31,000 use school radio broadcasts; 9,000 use television. The audience for radio "Further Education Series" averages around 50,000, and for television "Further Education Series" of a popular kind may reach 500,000. Audiences of specialised minorities can be very high, for example, in the case of doctors, reaching 25 per cent of the potential professional audience in the target areas.

The BBC puts out 65 radio and 40 television transmissions for schools and Technical colleges every week. In addition to series with national coverage on radio or television, there are special radio series for schools in Scotland, Wales and Northern Ireland separately; and similar special television series for Scotland and Wales.

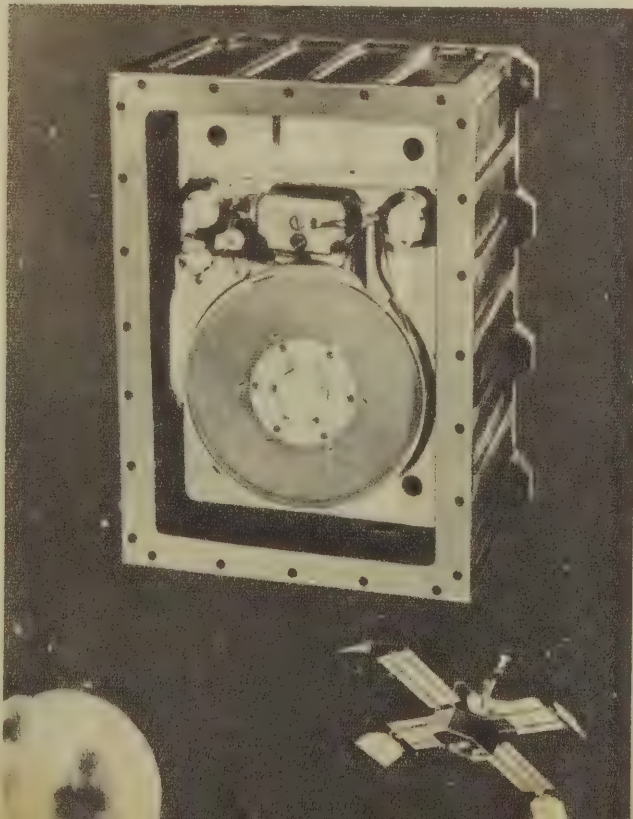
To accompany these broadcasts the BBC publishes teachers' notes and pupils' pamphlets. In the coming school year, 422 separate publications will be issued and the total copies distributed will be in the region of 12 million. In addition, 42 filmstrips will be available.

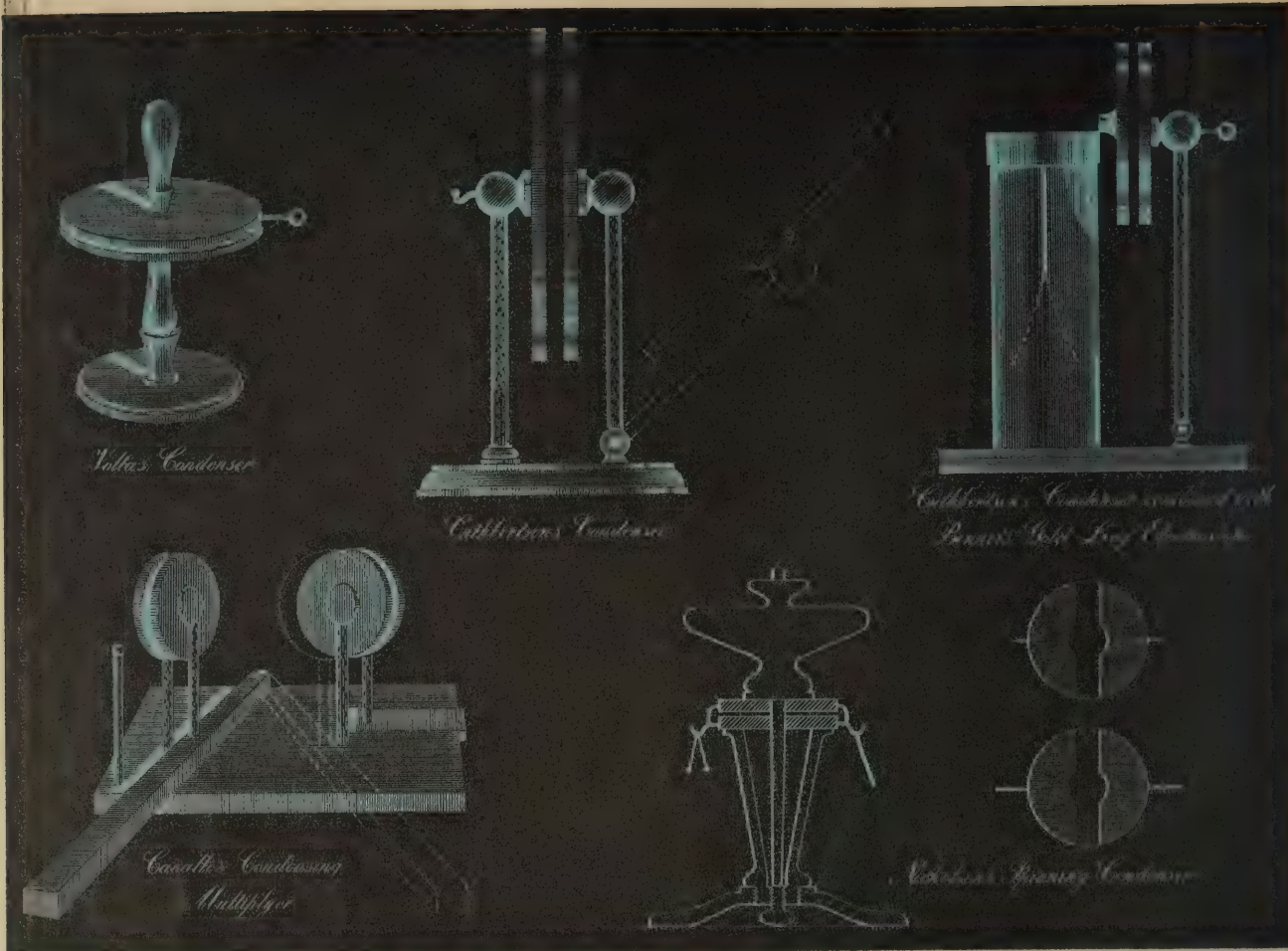
Liaison with the school world is maintained, on a massive scale, through the School Broadcasting Council and their committees and the BBC Education Officers. For example, in 1964: 108 teachers served on the School Broadcasting Councils and their committees; 28,000 teachers attended BBC lectures and demonstrations; 20,327 reports on broadcasts were received from teachers. For overseas, mainly Commonwealth countries, the BBC, in conjunction with the British Council, issues special educational recordings backed by literature, runs a strip loan scheme, and gives advice and training to educational and broadcasting staff.



From Elliot-Automation, 34 Portland Place, London, W1, comes this most recent picture of the "head-up" data display system, which the company produces. Essential flight data is superimposed on the view seen through the cockpit window. ("ELECTRONICS Australia" May, 1965).

40 million dollars, a journey of 350,000 miles and a 228-day flight took this tape recorder to the immediate vicinity of the planet Mars. In the ultimate, the information which the satellite was able to collect, was concentrated on 330 feet of "Scotch" brand instrumentation tape.



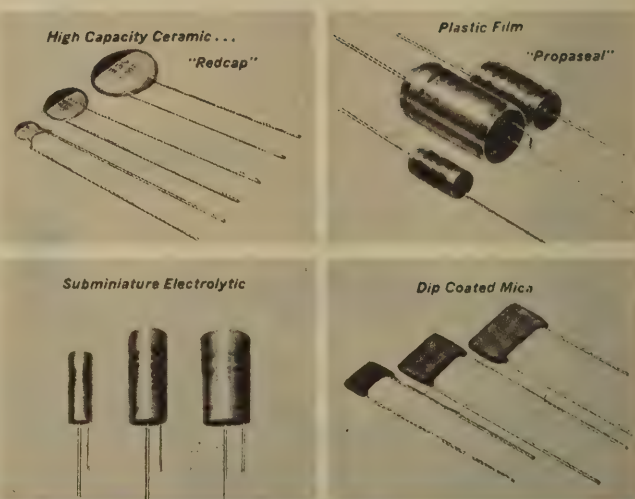


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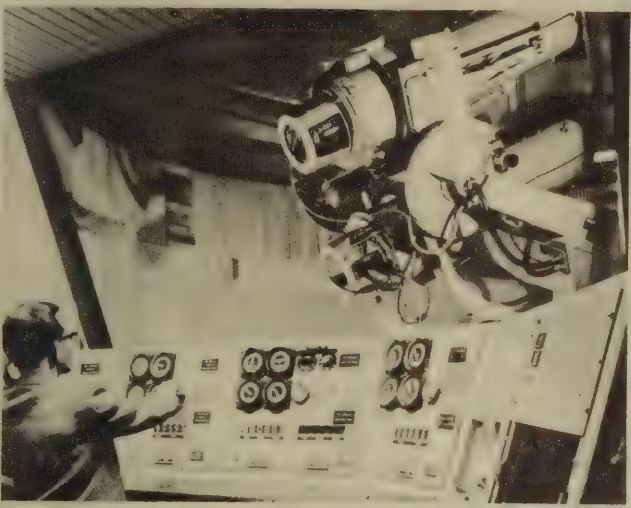
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Ultrasonic Diagnosis

Ultrasonic frequencies used for medical diagnosis may well be varied for optimum results, some tissues reflecting according to the wavelength used. London Hospital prostate examinations, using a small, rectal probe with an ultrasonic beam which is rotatable through a right angle, revealed that, at five megacycles per second, bone showed up clearly but no prostate echo was registered. At half this frequency the bone had been "tuned out" and the gland appeared. Many successful examinations were made, some clearly indicating cancerous prostates, and a hospital spokesman described the apparatus as "... simple, quick, painless and ideally suited to routine out-patient procedure."

Echo encephalography, with rays beamed through the temporal regions of the head, has already proved its value to neurologists, especially in locating and measuring lesions and shifts in the midline structure of the brain. Shifts caused by tumours and tumours themselves have been plotted. In cases of serious brain injury there is said to be considerably less risk than in investigation by X-rays.

Echograms of the lungs—taken at the bedside—have clearly revealed accumulations of fluid between lung and chest walls. The extent of this pleural effusion is measured by distinct echoes



At the Royal Observatory, Edinburgh, Scotland, new twin 16-inch telescopes are fully and automatically controlled from a console, while all settings and measurements are recorded directly on to computer tape.

which show the separation of the pleura and the exact needle point at which fluid can best be drawn off.
S. Smith and Sons Pty. Ltd., 52 Ferndell St, Granville, N.S.W. and Melbourne.

Tough Glass

The mechanical strength and resistance to thermal shock of glass can be increased more than twofold, it is claimed, by means of a new treatment developed by Gosudar Stvenny Nauchno-Issledovatel'sky Institute Stekla, Bouivar Semenovskaya 10, Moscow. The treatment, which is stated by the Institute to enable glass to resist great jumps in temperature, is particularly useful for producing special lenses, parabolic reflectors and window panes.

Electronic Proof-reader

The machine has stormed another human bastion. Proof-reading once requiring 20 man hours can now be completed in less than 10 minutes by a digital plotter.

"We call it 'instant proof-reading,'" said Lester L. Kilpatrick, president of California Computer Products, Inc. Kilpatrick said that a digital plotter manufactured by his company in Anaheim, California, U.S.A., is used to check the accuracy of control tapes for automated machine-tools in experiments at IIT Research Institute in Chicago.

"An error in the control tape shows up as a 'bulge' on otherwise smooth lines when the data is plotted in graphic form," Kilpatrick said. "It would take at least 20 hours for a man to check the 240 pages of numbers recorded by computer on the tape. A CalComp plotter pinpoints errors in less than 10 minutes."

Kilpatrick said the digital plotter "has become a very impotent and addition to the data processing function of the digital computer."

He cited contour maps of potential oil-yielding areas, automatic weather maps at government weather stations, air traffic recording, atomic structure analysis, navigation, sales analysis, inventory analysis, and brain pattern analysis as "a few of the many applications."

"Brain pattern analysis by digital plotter may help speed the day when American astronauts reach the moon," he predicted, "and it may decide which astronauts will go." Literally miles of data compiled in astronaut space environment reaction tests are being analysed by computer, programmed on tape and drawn as significant brain wave "maps" by a digital plotter, he explained. (In Australia—Ronald J. T. Payne Pty. Ltd., 385-387 Bridge Rd, Richmond, Vic.)

Warning Lights For Accumulators

Accumulator warning devices which blink a red light when re-charging is required have been developed by the Exide Division of Electric Storage Battery Company, Rising Sun and Adams Avenues, Philadelphia, Pennsylvania. The solid state device is designed primarily for electric vehicles such as fork lift trucks, but it could be converted for use on car batteries.

Laser Dust Detector

Historically, the most efficient dust hunters have been the housewife and the Army sergeant. Now scientists have developed a laser device that outstrips even the classical dust-hunting champions. With it, they expect to learn more about the composition of the upper atmosphere.

A high-power laser transmitter, to be used essentially as the active element of an optical radar, is capable of detecting minute particles of dust and micrometeorites; it will be used in upper-atmosphere geophysics research.

The high power of the laser — 10 million watts peak power at a rate of one pulse per second — was achieved by the development of a new, highly efficient tuning system for both the flash tube and the ruby laser.

The laser transmitter was built by R.C.A.'s Aerospace Systems Division for the University of Adelaide, Australia. It is similar to the one R.C.A. built for the Massachusetts Institute of Technology in 1963. The M.I.T. laser, one of the highest powered lasers in operational use at that time, was also used



At London's Middlesex Hospital, closed circuit television teams up with a low-powered X-ray system, allowing the surgeon to provide continuous visual X-ray monitoring for cardiac, urological and renal treatment. A second system can be used to display the patient's electrocardiogram and/or his respiration and pulse rates.

in an optical radar. It was able to detect dust believed to have originated from fragmented meteors, and could do so at a distance of 85 miles into the stratosphere. The new University of Adelaide laser transmitter has approximately twice the capability of its predecessor.

King-size Tape Recorder

A giant tape recorder — one of the most advanced and perhaps the largest in existence—has been delivered to the Advanced Research Projects Agency by R.C.A.'s Missile and Surface Radar Division.

The seven miles of tape on the machine's huge reels hurtle through its guides at a speed of more than 60 miles per hour. The usable length of the tape is five miles. A mile of tape is used to accelerate to the mile-a-minute speed, and a mile is required to stop the machine. The tape is supported and lubricated by compressed-air bearings to minimise friction at the high speed, and mechanical tolerances on critical parts of the machine have been kept to millionths of an inch.

The mammoth recorder is capable of taping and playing back 12 television programs simultaneously, but it will be put to a somewhat different use: recording radar signals obtained from ballistic missiles.

On 14 of its 15 channels, the machine records data on targets within the radar beam. This information can be played back through the radar system for analysis of the characteristics of the ballistic devices.

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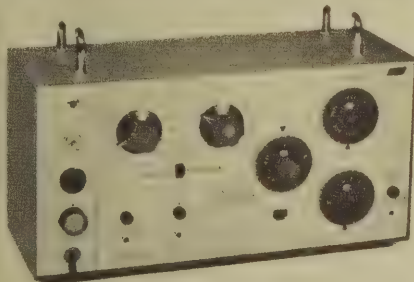
Warns of Road Hazards

Drivers are warned of road hazards through car radios in a system demonstrated by the Ford Motor Company of the American Road, Dearborn, Michigan, U.S.A. The hazards—ice, fog or accident ahead—are recorded orally on a magnetic tape in a device attached to the car radio. Ordinarily, the device is silent. However, if triggered by a road-side warning transmitter, the tape delivers the message over the car radio, whether it is receiving a program or not.

The roadside transmitter can be a fixed installation turned on from patrol headquarters when fog or ice are reported. Or it can be a small box left beside the road by a patrol car to warn of an accident ahead. A transmitter carried on an ambulance or fire brigade equipment can warn motorists it is approaching if the proper wording is put on the tape. The driver would receive this even if he were in his car with all windows closed and radio going full blast on a program.

Radiation Doses

Soviet scientists and engineers have designed a special electronic computer named Dosa for determining the doses of irradiation in the treatment of tumours. With it, the procedure becomes automatic, and the time requirement is cut down appreciably. In the case of 24 areas of irradiation,



This French-manufactured Fluctuation Simulator GST1 is designed for checking fluctuation meters in accordance with ITCC standards (Geneva 1963). Fully transistorised, it is available from Laboratoire Electro-Acoustique, 5 Rue Jules Parent, Rueil Malmaison, France.

for example, the computer determines and records the total dose for a single point inside five seconds, while the complete procedure of determining the overall dose occupies a half-hour. The computer can be easily re-set, if the input data, such as the depth of the tumour, the number of irradiation fields, etc., vary. The synchronisation unit of the computer synchronises the input of the variables with the type-written read-out.

Sensing Icy Roads

An electronic ice detector for roads has been developed by Findlay Irvine, of Bog Road, Penicuik, Midlothian, Scotland. Named the Static Iceclert, the device senses conditions likely to lead to ice on the road and automatically warns oncoming traffic or sends a signal to the gritting depot. Basis of the device is three electronic probes which sense temperature, moisture and snow or ice. The probes are normally buried in the road surface and connected by cable to the control box. The system operates from mains electricity supply.

Microwave Oven

A new, low-cost, compact microwave oven has been announced by Litton Industries in the United States.

The stove is built by Litton's Atherton

Division. Known as the "Litton 500," it measures 21 5/8 inches wide, 14 7/8 inches high, and 21 1/4 inches deep and weighs half as much as conventional equipment.

The new oven, which heats deep-frozen food to eating temperature in a matter of seconds, is selling in the U.S. for between 695 dollars and 850 dollars, depending upon quantity purchased. This is approximately one-third less than the price for conventional commercial microwave ovens.

There are no chances for burns from hot utensils or oven fumes. The heating process does not begin until the door is closed and the timing mechanism started. (Litton Industries, Beverly Hills, California, U.S.A.)

Photo-recording Data

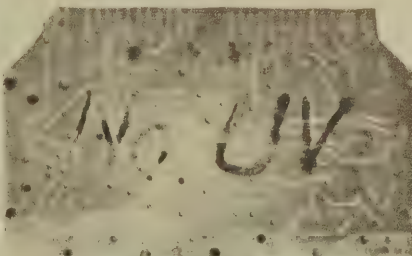
A new ultra-high-speed digital printer, which records 192,000 characters per minute on photo-sensitive paper, has been introduced by the Monroe Data/Log division of Litton Industries. The MC 4000 printer will have wide uses where very rapid print-out of computer data is required, according to M. L. Bright, general manager of the Monroe Data/Log division.

The new unit overcomes problems of punched tape recording which is too slow, and magnetic tape, which is fast but not visible. The new unit prints 360,000 lines of recorded data per hour. Bright explained the MC 4000 accepts coded input, converting it to digits of alphabetical characters. These are registered on the head of a cathode ray tube. A fibre optics bundle intensifies this image on the photo-sensitive paper, greatly speeding the printing and creating a clearer copy.

It records 100 lines of data per second without heat, drying, or photo chemicals. (Monroe Data/Log Division, 343 Sansome St, San Francisco, Calif. U.S.A.)

Converts Tape Data

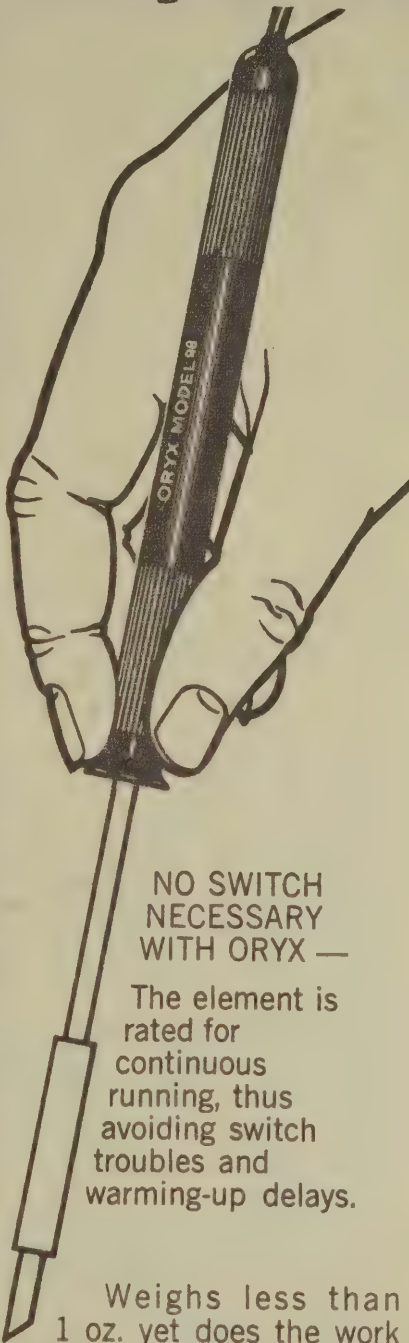
A new off-line system which converts computer data from all types of currently used punched paper tape to magnetic tape at half the cost of previous methods has been placed on the market by Ampex Corporation. The Ampex Model PTS-1000 will perform routine data conversion without tying up a computer. The system offers substantial savings for many commercial and government data processing users by freeing the computer for more complex work. The PTS-1000 also will enable users to feed converted information into computers up to 120 times faster than now possible. Paper tape data can be fed into computers at approximately 1,000 characters per second; the same data converted to magnetic tape can be fed in at speeds of 40,000 to 120,000cps. (Ampex Computer Products Division, Culver City, California, U.S.A.)



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The Hall Effect

Semiconductor devices which utilise the so-called Hall Effect are finding increasing use in modern electronics. In their basic form they are fine for measuring and plotting magnetic fields; more exotic applications include uses in displacement transducers, current and power measurements, analogue multipliers, modulators and detectors. This article explains their operation and use, and also gives details of a Hall Effect kitset recently made available for experimenters in the home, school or research laboratory.

IN 1879, Edwin H. Hall of the Johns Hopkins University published a paper in the American Journal of Mathematics entitled "On a New Action of the Magnet on Electric Currents." In the paper he described an interesting effect which he had observed in experiments with magnets and currents flowing in thin conductors: in a magnetic field, a microscopic voltage appeared between the edges of a thin conductor carrying current.

Hall's apparatus took a form something like figure 1. When current was passed through the thin strip of copper in the absence of the electromagnet, the galvanometer registered nothing. But when the strip was placed in the magnetic field, the galvanometer indicated that a tiny voltage was generated across the width of the strip.

When Hall reversed the direction of the field, the voltage reversed in polarity; when he varied the current in the conductor, or the strength of the field, the voltage varied proportionally; if he varied both current and field, it varied proportionately to their product. Tilting the conductor along either its longitudinal or latitudinal axes showed the voltage to depend also on the angle between the plane of the conductor and the field.

Although Hall's paper and the effect which it described were of considerable academic interest, little practical use could be made of what was henceforth called the "Hall Effect." This was because the voltages which Hall had observed had been quite microscopic — at microvolt level, visible only on a sensitive galvanometer.

The phenomenon remained at the level of a scientific curiosity until quite recently, when an important discovery was made. This was that, although the Hall Effect was microscopic in metallic conductors like copper, gold and iron, it was some 100,000 times stronger in certain semi-conductor materials. In particular, the intermetallic compounds Indium Arsenide (InAs) and Indium Antimonide (InSb) proved to have a very pronounced Hall effect.

Using these materials, it has proved possible to develop practical Hall Effect devices with applications in almost every field of modern electronics. We shall examine some of these applications later in this article but, before doing so, it would perhaps be of interest to look a little closer at the principle of operation of the Hall device.

The Hall Effect is perhaps best considered a special application of what is

often called the "Lorentz Force"—the deflection of charged particles moving in a magnetic field. As such it is closely related to such familiar phenomena as the magnetic deflection of the electron beam of a television picture tube, the force experienced by the coil of a moving-coil meter and the operation of an electric motor.

An electron moving in a magnetic field experiences a deflecting force which acts in a direction perpendicular to both the path of the electron and the direction of the field. The amplitude of the deflecting force is proportional to the charge of the electron, the magnetic flux density and the effective velocity of the electron in a direction perpendicular to the field.

$$\text{i.e., } F = q.B.v.\sin A,$$

where F is the deflecting force, q is the charge of the electron, B is the flux density, v is the velocity and A is the angle between the electron path and the field.

In the Hall device the electrons under consideration are those comprising the current flowing along the length of the thin conductor—the so-called "control current." As these electrons move

through the conductor and through the field they experience a deflecting force according to the above equation. The force tends to push them sideways, so that they veer to one side of the strip.

As a result, the current density throughout the width of the conductor is non-uniform — very little current flows along one side, while a large proportion flows along the other. If one were to examine a cross-section of the conductor one would find a current density gradient from one side to the other.

At any given instant, the side of the conductor carrying the greater part of the current will have more electrons per unit area than the other side. In other words, the current gradient from one side to the other produces a corresponding charge gradient. And the effect of the charge gradient is to produce a potential difference between the sides of the conductor; hence the appearance of the Hall voltage.

The polarity of the Hall voltage will fairly obviously depend upon the direction in which the current electrons are deflected; the side towards which they are deflected will become negative with respect to the other. The direction of deflection can in turn be predicted using the familiar "Right Hand Rule," giving the direction of the force on an electron moving in a field:

Extend the thumb, first and second fingers of the right hand so that they are mutually perpendicular. Then let the first finger represent the direction of the field, and the second the direction of electron flow; the direction indicated by the thumb will show the direction in which the electrons are deflected.

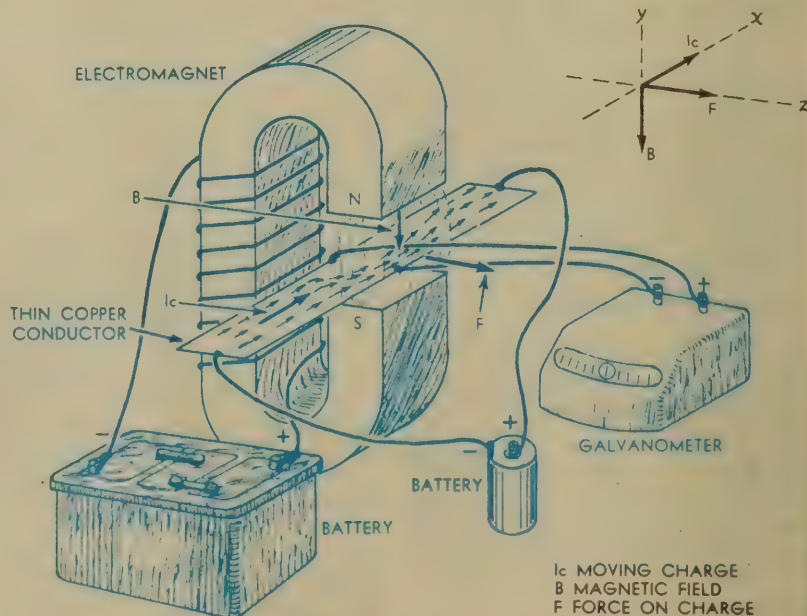


Figure 1: An idea of Hall's original experiment. When current flowed through a thin conductor placed in a magnetic field, the galvanometer showed that a microscopic voltage appeared between the sides of the conductor.

WHAT IT IS, AND WHAT IT CAN DO

by Jamieson Rowe

(This rule is based upon empirical observation, although it can be supported by a consideration of the interaction between the magnetic field already present and that associated with the moving electrons. For those whose electronic education was based upon the old "conventional current flow" concepts, the rule is simply the old "Left Hand Motor Rule" transposed.)

The amplitude of the Hall voltage depends, as Hall himself observed, upon the current in the conductor, the magnetic flux density and the angle between the plane of the conductor and the magnetic flux. It also depends upon the thickness of the conductor and the material from which it is made.

For an ideal Hall element having an infinite length-to-width ratio the Hall voltage would be given by

$$V_h = \frac{R_h \cdot I_c \cdot B \cdot \sin A}{t}$$

where V_h is the Hall voltage, R_h is the so-called "Hall constant" of the material, I_c is the (control) current, B is the magnetic flux density, A is the angle between the plane of the element and the magnetic flux, and t is the element thickness.

However for practical Hall devices the finite length-to-width ratio modifies the relationship to

$$V_h = K_{hoc} \cdot I_c \cdot B \cdot \sin A$$

where K_{hoc} is a constant taking into account the Hall constant of the material and the dimensions of the device.

A typical Hall device consists of a wafer of Indium Arsenide some .08in x 0.18in mounted for protection on a sliver of substrate material measuring 0.50in x 0.13in. The overall thickness may be as low as .006in for use in measuring fields in thin gaps.

Control currents of the order of 150mA are typical, and an average device produces some 100mV of output in a perpendicular field of density 1 Weber/square Metre (10 Kilogauss).

Ideally, a Hall device would produce zero output voltage when there is no perpendicular component of magnetic field. However practical Hall elements do produce a small output under these conditions, and it is the aim of the



This gaussmeter uses a Hall device to give a direct reading of magnetic fields from 0.1gauss full scale to 30,000gauss full scale, from DC to 60cps. A suppressed zero scale expansion facility allows incremental measurements of better than 1 part in 1000. (Bell "240" Incremental Gaussmeter, courtesy Tecnico Electronics Pty. Ltd.).

device designer to reduce this "null voltage" to a minimum.

It is usual to distinguish between two components of the null voltage. The term "resistive null voltage" is used to lump together residual voltages due to misalignment of the output electrodes on either side of the Hall element, thermal effects and rectification at the electrode connections. Output electrode alignment is important because, unless the two electrodes are exactly opposite one another they will pick up a component of IR voltage drop due to the control current.

When the Hall device is used in applications involving time-varying magnetic fields, particularly at high frequencies, there is a second main source of null voltage — inductive pickup. The element and its leads act as a half-turn pickup loop, and an induced voltage appears which is proportional to the effective area of the pickup loop. Null voltage of this type can be kept to a minimum by keeping the effective pickup area of the device and its leads as small as possible.

With careful design the resistive and inductive null voltages of a Hall device can be kept to a very low level —

of the order of 0.1mv for resistive null voltage and .0002mv per Weber/sq. Metre/sec for inductive null voltage. For applications where even these levels prove embarrassing there are ways of cancelling them out using bridge techniques.

With most practical Hall devices there is an optimum load resistance associated with the output electrodes. When this resistance is connected between the electrodes, the relationship between output voltage and magnetic flux density is usually linear to within about 1 per cent.

Having looked fairly closely at the development and operation of the Hall device we should now be in a position to examine some of its applications.

Perhaps the most obvious application lies in plotting and measuring magnetic fields. By supplying the Hall device with a direct control current and connecting a sensitive DC millivoltmeter circuit to the output electrodes we obtain an excellent "Gaussmeter." Such an instrument is invaluable in much scientific research and industrial design, where magnetic fields must be measured and plotted.

An advanced instrument of this type

HALL DEVICE DISPLACEMENT TRANSDUCERS

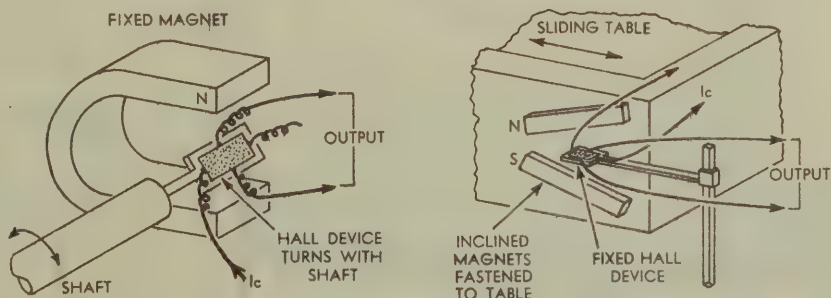
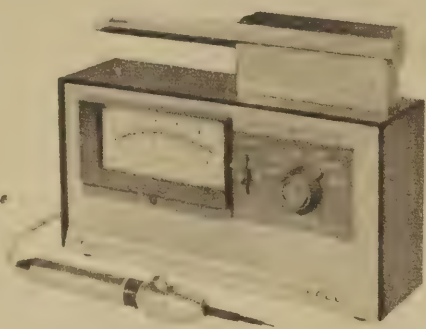


Figure 2: The use of Hall devices in displacement transducers. At left, an elementary transducer for the position of a rotating shaft; at right, a transducer for a linear or sliding movement.

F. W. BELL HALL EFFECT GAUSSMETERS



The range of gaussmeters from F. W. Bell Inc. of U.S.A. operate on the Hall Effect. They are direct reading, high sensitivity instruments for measuring direction and magnitude of magnetic flux density, for plotting flux paths and for measuring flux leakage. They are designed for use in schools, research laboratories, inspection departments, semiconductor factories — for testing relays, loud-speakers, microphones, DC motors, speedometers, voltage regulators, thermostats—and for a host of other applications in the design, manufacture and testing of electronic equipment.

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is pictured. It will measure DC (static) fields as low as 0.1 gauss (.0001 W/sq.M) and up to 30,000 gauss (3.0 W/sq.M) over five measuring ranges. Reading accuracy is quoted in the manufacturer's literature as ± 1.0 per cent up to flux densities of 10,000 gauss.

It will measure weaker fields (down to .001 gauss) using flux concentrating devices, also increments in flux density and AC fields. Probes are available in a number of forms, suitable for mak-

clip-on Hall probe. The Hall device is equipped with hinged pole-pieces which clip around the conductor of interest and sample its surrounding magnetic field. As the field is proportional to the current flowing the output of the Hall device will be similarly proportional, and a DC or AC millivoltmeter connected to its output electrodes may be calibrated directly in terms of current.

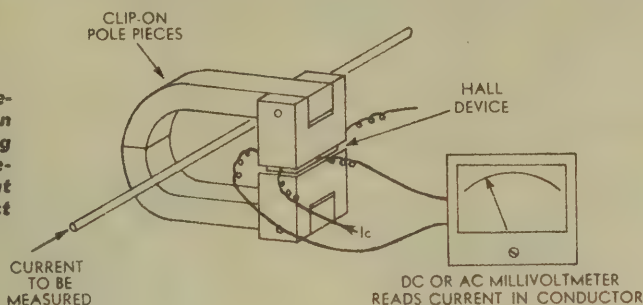
Because the Hall device has the ability to act as an analogue multiplying

used for power measurements; wide-band wattmeters using such multipliers are used to make power measurements up to 3KW at frequencies up to 50KC. Hall wattmeters may be used on either DC or AC, which makes them very attractive instruments.

To make power measurements in a circuit, the two inputs of the Hall multiplier are fed signals proportional to the current and voltage present; the output will then be proportional to the instantaneous product of current and voltage. Suitable metering circuitry connected to the Hall output terminals can thus be calibrated directly in VA or watts, as desired.

The Hall multiplier may be used as a type of modulator or mixer for AC signals. Since the output is proportional

Figure 3: An elementary clip-on probe for making current measurements without breaking the test circuit.



ing axial or transverse measurements in confined areas.

Another big application for the Hall device is in displacement transducers, used to convert the linear or angular position of a machinery part or other moving body into an electrical signal. Such transducers play a big part in the automatic control of machinery and processes, for instance, as they provide the "sense receptors" of the automatic control system. By means of transducers the system is fed the information it needs concerning the position and movement of any controlled or reference device.

A Hall device is used as a transducer of this type by arranging that the linear or angular movement of the device in question causes a variation in the magnetic flux density. Either the Hall element and a magnet are fixed, and a piece of iron attached to the moving part so that it has a varying effect on the field, or one of the two is fixed and the other attached to the machinery part.

Thus for converting the angular position of a shaft into an electrical output, the Hall device may be attached to the end of the shaft and arranged to turn in the field of a fixed permanent or electro-magnet. For monitoring the position of a sliding rod or milling machine work-table, magnets may be fixed to the rod or table so that they move past a fixed Hall device. These configurations are illustrated in figure 2.

A Hall device may be used to make "clip-on" current measurements in circuits, i.e., measurements made without breaking the circuit. While such measurements can be made in medium- to high-current AC circuits using probes which rely upon transformer action, a transformer probe is rather impractical where such measurements must be made in low-current AC circuits. And it is of course useless in circuits carrying only direct current.

In contrast a clip-on probe using a Hall device can be used even in low-current circuits, and is equally suitable for both AC and DC—with the proviso that for measurements involving high frequencies, the effect of inductive null voltage pickup is cancelled.

Figure 3 shows the basic idea of a

element it is finding ever-growing uses both as a "straight" multiplier in analogue systems and in derivative applications such as power meters, modulators, detectors and attenuators.

The ability of the Hall device to act as a multiplier stems from the relationship between the Hall voltage V_h , the control current I_c and the flux density B . From the equation given earlier, it is evident that if the Hall constant K_{Hoc} and the angle A are kept constant, then V_h is directly proportional to the product of I_c and B .

Thus if I_c is made proportional to one variable input quantity and B is made proportional to another, the instantaneous amplitude of V_h will be directly proportional to the product of the instantaneous values of the two inputs. The Hall device "multiplies" the amplitudes of the two inputs together to produce an output.

Hall devices intended for use as multipliers are packaged complete with a magnetic core and set of windings, so that both inputs may be in the form of currents. Figure 4 shows the arrangement in basic form.

A Hall multiplier of this type can be

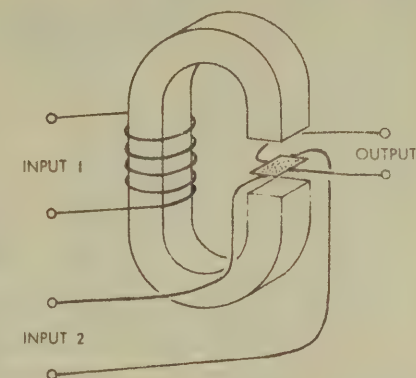


Figure 4: The principle of the Hall multiplier. The Hall output is proportional to the product of the inputs.

to the instantaneous product of the two inputs, it will contain sum and difference frequencies when AC signals are used:

$$\begin{aligned} \text{If input 1} &= A \cos 2\pi f_1 t \\ \text{and input 2} &= B \cos 2\pi f_2 t \\ \text{then output} &= K_m A \cos 2\pi f_1 t \\ &\quad \cdot B \cos 2\pi f_2 t \\ &= K' AB \cos 2\pi(f_1 - f_2)t \\ &\quad + K' AB \cos 2\pi(f_1 + f_2)t \end{aligned}$$

where K_m and K' are constants associated with the Hall multiplier.

Note that neither of the input frequencies appears in the output; as a modulator the device thus exhibits the characteristics of double-sideband suppressed carrier modulation. If the

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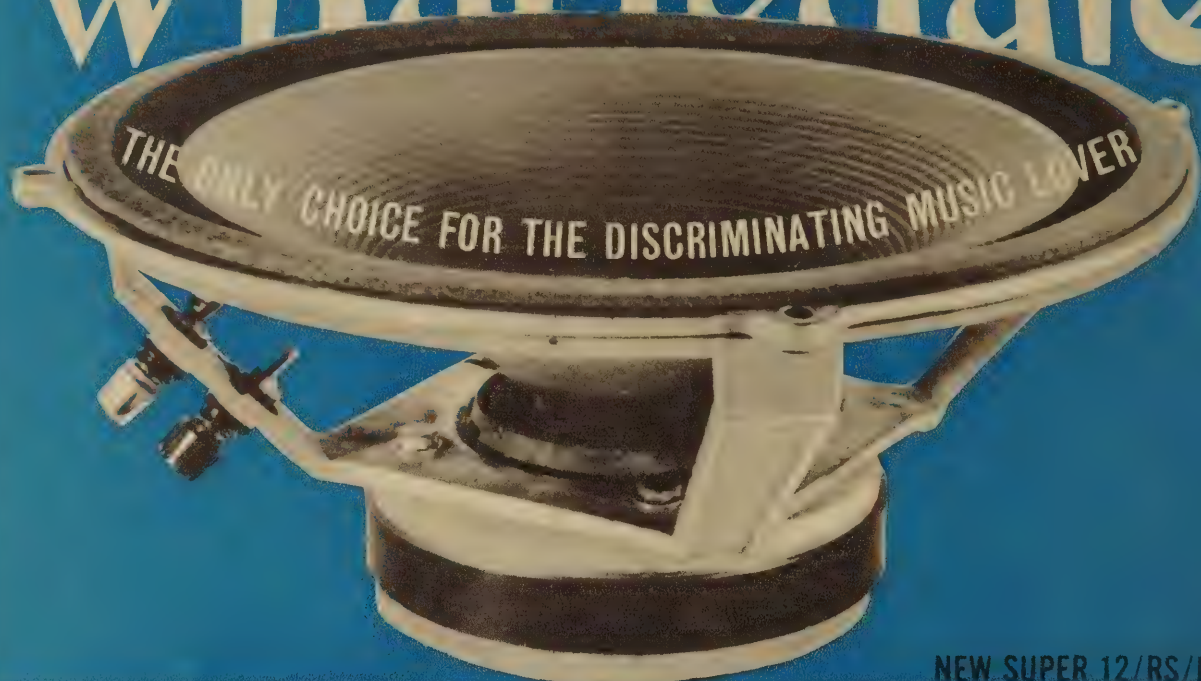
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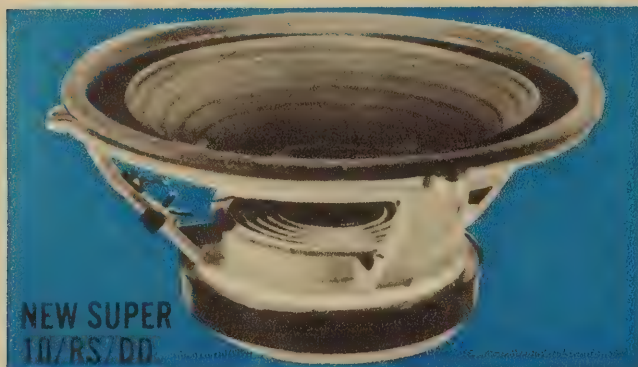
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carrier were required, the appropriate input could be added separately to the output. As a mixer the multiplier operates linearly over a very wide range in amplitude.

As it can operate as a mixer the Hall multiplier is ideal as a detector. With both inputs connected in series it will operate as a square-law detector; by feeding one input with a reference signal equal in frequency to the carrier with zero modulation it can be operated as a synchronous detector.

Because the output of the Hall multiplier is a function of both inputs, a DC signal fed to one input may be

standard VTVM or oscilloscope. If static fields are to be measured, a DC meter or CRO is necessary, unless AC is fed to the Hall device; the latter may be advisable when measuring small fields, as it obviates amplifier drift. For measuring AC fields, this problem does not arise and a millivoltmeter or AC oscilloscope may be used.

As the preamp. becomes non-linear with outputs greater than 3V terminals are provided for direct connection to the Hall device output. The output level from these terminals is from 10 to 30mV per 1,000 gauss.

Tested in our laboratory, the kit

This Hall effect kitset is available locally. It features an Indium-Arsenide Hall device, a two transistor differential preamp and calibrating magnets, together with descriptive literature. (Tecnic Electronics Pty. Ltd.).



used to vary the transmission of the device with respect to a signal fed to the other input. Thus the multiplier may be used as a noiseless linear attenuator.

Other uses for Hall multipliers include analogue squaring and function generation; choppers for DC amplifiers; frequency doubling; power factor and phase measurement; and spectrum analysis.

It should be evident from the foregoing that the Hall device and its derivative the Hall multiplier are components of wide and varied application. Because of this, engineers, scientists, technicians, schools and home experimenters will no doubt be interested in becoming familiar with the devices and their operation.

It should thus be of particular interest to readers to learn that an experimental Hall effect kit is available locally. Marketed in Australia by Tecnic Electronics Pty. Ltd., of 53 Carrington Road, Marrickville, N.S.W., it is called the **Bell Hall-Pak Kit**. The manufacturer is F. W. Bell, Inc., of Ohio, U.S.A., maker of a wide range of Gaussmeters and Hall multipliers.

The kit comprises a Bell Hall-Pak device, a two-transistor differential amplifier on a printed wiring board, two calibrating magnets and tutorial and applications literature. It comes attractively packaged in a clear plastic case measuring 7in x 3½in x 1½in.

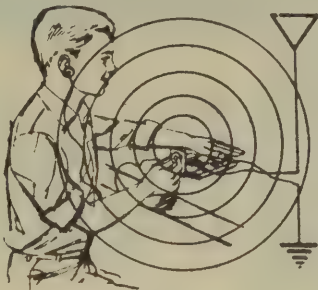
When connected up and powered by two 6V lantern batteries, the kit gives an output of the order of 3V per 1,000 gauss (0.1W/sq.M). The output is thus suitable for measurement using a stan-

assembled easily and proved suitable for plotting fields, examining stray fields of loudspeaker magnets, and so on. With the output of the preamp. connected to a sensitive DC oscilloscope, it was even possible to illustrate the magnitude and direction of the earth's field.

Attempts to investigate AC fields using the assembled kit showed that the unbalance produced by connecting the output of the preamp to the unbalanced input of a normal CRO or VTVM makes capacitive pickup a problem in situations where a fairly intense dynamic electric field accompanies. In such situations, it would be advisable to use either a balance-to-unbalance matching device (such as a transformer) or a CRO or VTVM having balanced input to render the system less sensitive to such pick-up.

Apart from this, the measurement or investigation of AC fields is quite a straightforward matter. We were able to look quite easily at the fields surrounding power transformers, audio transformers, TV deflection transformers, deflection yokes and tape-recording heads, once we had surmounted the capacitive pick-up problem.

The kit would thus seem very suitable for experimental and demonstration work in schools, colleges, research labs and even the home workshop. It could conceivably be used as the basis of an economy Gaussmeter for industrial applications — although thermal and temporal drift, spurious pick-up and accuracy would no doubt be inferior to a fully designed commercial instrument such as that shown in the photograph.



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A NEW *Playmaster* PROGRAM SOURCE

Last month, we introduced a new AM radio tuner, which we designated the "Playmaster Program Source No. 111." In this issue, we conclude the presentation, covering circuit alignment, the provision of a whistle filter and the additions necessary to provide short-wave coverage.

PART TWO

AS explained last month, the new Program Source was designed to be as universal as possible, to meet the many and varied requirements of our readers.

On the one chassis, which can fit into a standard amplifier case, can be built a very simple 2-valve superhet tuner — or something much more complex, by reason of add-on options. These options include tuning indicator or tuning meter, in-built power supply, 10KC whistle filter and short-wave coverage.

The circuit presented last month, on Page 53, showed the new Program Source to the stage as then complete—with tuning indicator and in-built power supply.

This month's circuit supersedes the earlier one, showing also the additions necessary for a 10KC whistle filter. The circuit is drawn in such a way that readers should have no difficulty in selecting the portions they require.

To the top left is the major portion of the circuit involving the frequency changer and IF amplifier stages.

The simple detector, which is the same as shown last month, is picked out by the vertical blue stripe.

If you wish to include the whistle filter, ignore the components in this blue section and wire straight through to the 12AU7 stage at the top right, which also includes provision for detection and AVC.

The optional power supply, the magic eye circuitry and the position for a possible tuning meter are also self-evident.

The modifications for short-wave coverage are shown in a separate circuit, involving mainly the signal grid and oscillator sections of the 6AE8 frequency changer.

One small modification should be noted in the main circuit, namely the inclusion of a resistor in series with the H.T. supply lead to the magic eye tuning indicator.

Experience has shown that the indicators last longer if their target voltage is restricted to a figure no higher than necessary to give adequate brightness. Typical series resistor values lie between 20K and 100K. The resistor can be strung between the B-plus lug on the 5-tag strip supplying the indicator and pin 9 of the socket.

Before proceeding with further constructional information, it is appropriate first to take up the threads of last month's article and to cover the alignment procedure.

If the wiring is free from errors and



The dual-wave version is similar to the broadcast version except that the centre knob becomes a wavechange rather than an on-off switch. The dial glass should logically carry short-wave calibration as well as broadcast band.

the tuner is connected correctly to the amplifier system, it should operate at switch-on. Its ultimate performance, however, and the position of stations on the dial will depend on proper alignment of the various tuned circuits.

An initial precaution, before commencing alignment, is to see that the pointer is set correctly in relation to the scale. If the scale has a "set pointer" mark, the pointer should correspond with this when the tuning gang is fully

ing paragraphs should, however, assist those who have no other reference available. The procedure will vary according to whether or not a calibrated signal generator (or service oscillator) is available.

If using a signal generator, the first step is to set the generator dial to 455-KC and, by feeding the signal through from the mixer grid, to peak the four IF transformer windings for maximum response.

By Michael Meechan and Neville Williams

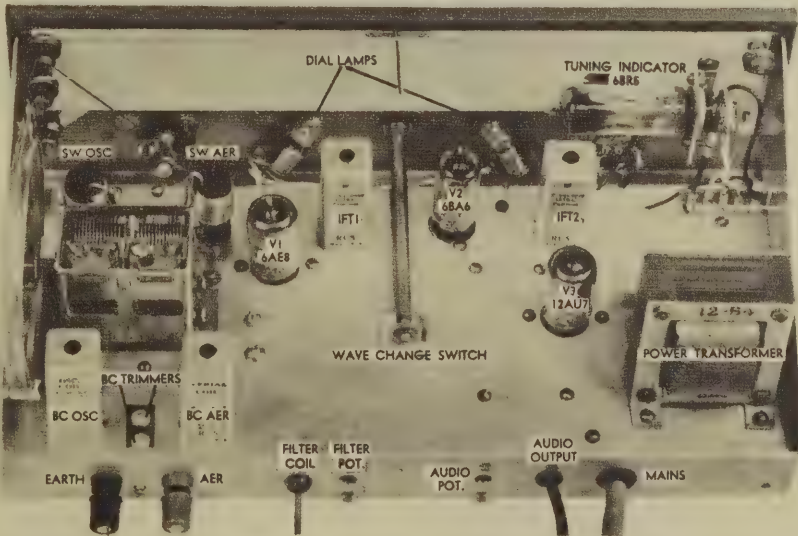
in mesh. In the absence of such a mark, arrange matters so that the pointer over-runs the calibrations on the dial by an equal amount at either end of its travel.

A further point is that alignment should only be attempted with the selectivity switch in the "Normal" position — that is with S1a and S1b in position 2 on the circuit. All four IF windings then function normally.

In these circumstances, the alignment procedure is quite straightforward and readers may follow any appropriate set of alignment instructions. The follow-

A point to watch, when aligning the IF transformers is that, in many types, the adjustable slugs can be screwed right through each winding, so that two peaks can be found, one with the core passing from the end of the former into the coil, and another with the slug passing beyond the coil towards the centre of the former and the adjacent winding.

Unless there are specific instructions to the contrary, the cores should always be peaked in the outer position, that is, furthest away from the centre of the former and the adjacent winding.



This rear view of the chassis shows the wavechange control spindle, the 10KC whistle filter stage and the modified layout along the rear of the chassis, as foreshadowed last month. The blueprint released to chassis manufacturers is in accordance with this picture.

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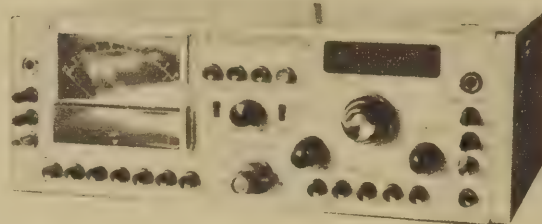
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minus 10, minus 20, minus 30,
minus 40, minus 50, minus
60 dBm.
(Built-in attenuator.)

Frequency characteristic
Input impedance 600Ω or $10K\Omega$ within ± 0.5 at 20 c/s—60 kc.

Input impedance $100K\Omega$ within ± 0.5 at 20 c/s—600 kc.

Accuracy within $\pm 5\%$ of full scale.

Distortion measurement

Fundamental frequency 20 c/s—200 kc, 5 ranges.

Input impedance 600Ω or $10K\Omega$ 50 c/s—20 kc.

High harmonics range within ± 0.5 dB up to 60 kc.
Input impedance 600Ω or $10K\Omega$

Input impedance $100K\Omega$ within ± 0.5 dB up to 300 kc,
within ± 1 dB up to 600 kc.

Distortion range 30%—0.1%
30%—0.2%

100 kc—200kc directly read at full scale, 30,
10, 3, 1, 0.3%

Input level range approx. -10 dBm— $+20$ dBm
(0.25V—7.75V)

Accuracy within $\pm 5\%$ of full scale of
each range.

Noise measurement

Measuring range 0 — -70 dB against signals
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 $+20$ dBm.

Frequency characteristic
Input impedance 600Ω or $10K\Omega$ within ± 0.5 dB at 20 c/s —
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Width 12 $\frac{1}{2}$ in.
Depth 14 $\frac{1}{2}$ in.

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Input impedance 1 Megohm
Input amplifier band width, -3 dB at:—
2,500 and 3,500 c.p.s.

Effective limiter range ± 10 dB
Meters 3 $\frac{1}{4}$ in. square faced instruments with 2 3-8 in scale (approx.)

Meter Scaling—"Peak Wow" 0 to $\pm 1.0\%$ (centre zero).
"Wow" and "Flutter" 0 to 1.0% R.M.S. and 0 to 0.2% R.M.S.

Cross over frequency 20 c.p.s.
"Flutter" meter response -3 dB at cross over.

"Wow" meter response -3 dB at 200 c.p.s.
 -3 dB at crossover.

C.R.O. Output level -1 dB at 0.5 c.p.s.
Approx. 1 V R.M.S. into 0.5 megohm for 1% R.M.S. deviation.

C.R.O. input frequency response Level down to zero frequency.
 -3 dB at 200 c.p.s.

Analyser output level Approx. 1 V R.M.S. into 0.5 megohm for 1% R.M.S. deviation.

Analyser output frequency response Level down to zero frequency.
 -3 dB at 200 c.p.s.

3,000 c.p.s. oscillator output 4V R.M.S. into 0.5 megohm.
level 75mV R.M.S. into 500 ohms.

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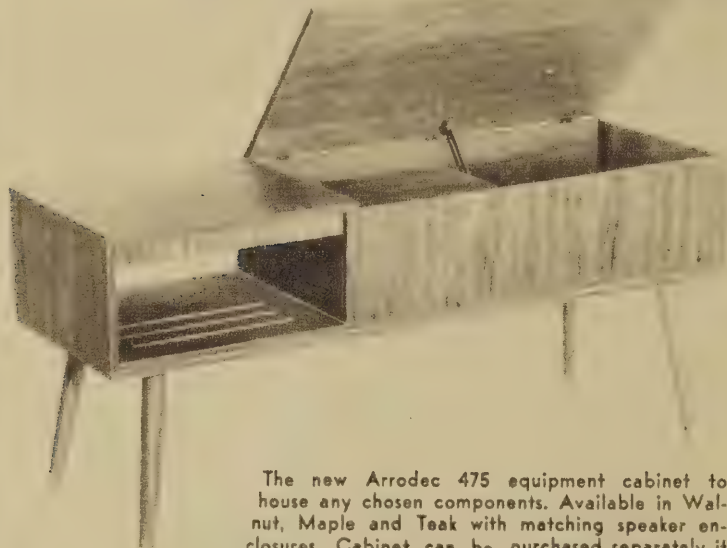
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PROGRAM SOURCE —Continued

is now a non-standard value. The particular coil which we bought over the counter would not resonate at 10KC with .0047mfd capacitors, the preferred value on the low side but it did resonate with the higher value of .0056. In fact, we ended up with a pair of .0068 capacitors, which put the slug at about the middle of its adjustment range.

Polyester capacitors were preferred because of their small size and ready availability. Conventional mica capacitors are bulky and expensive by present-day standards.

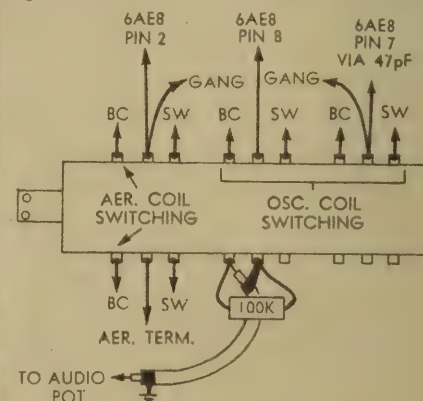
A point to note is the inclusion of a 10K resistor and an 8mfd capacitor in the HT supply to the cathode follower, as a precaution against hum.

The 12AU7 and its associated socket are situated in the 1in hole punched in the chassis immediately behind the second IF transformer.

The majority of resistors and capacitors used are accommodated on an 8-lug tag strip, just in front of the audio tab pot. The HT filter, the 1.5K cathode resistor and .1mfd output capacitor are strung point-to-point.

Note that the whistle filter coil is mounted on the rear apron of the chassis, with its associated tab pot, alongside. This arrangement makes both adjustments accessible from the rear, although, once the adjustments are made, it is a good idea to seal them in some way to discourage the attention of straying fingers!

In the specified position, the whistle filter coil is substantially on the centre axis of the power transformer, with its winding at right-angles to the transformer winding. In this position, its hum pickup is small enough to be disregarded.



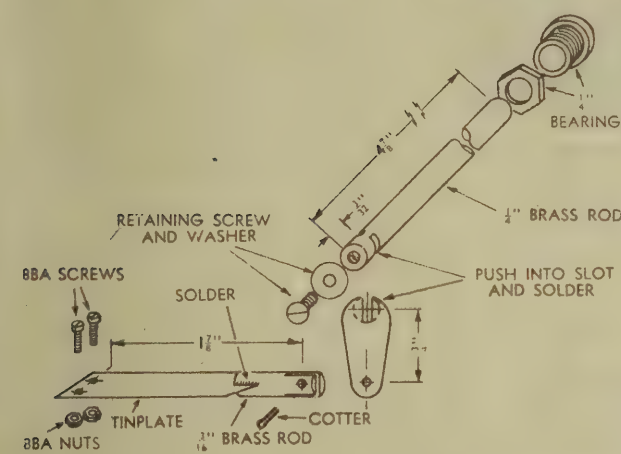
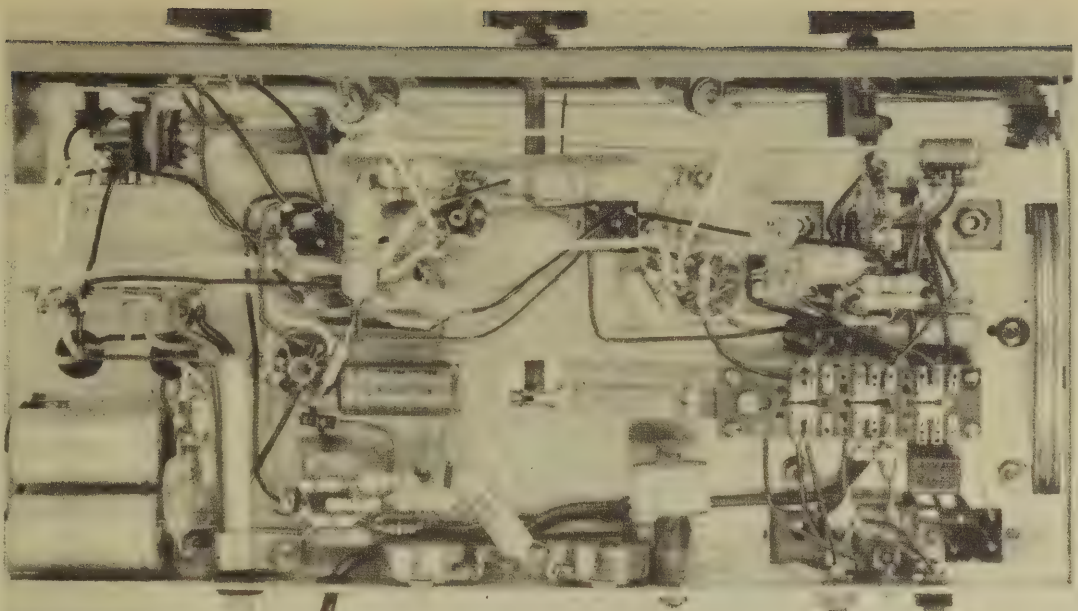
This diagram shows how the wave-change switch was wired in the prototype tuner. The "grid" ends of the SW coils connect directly to the respective trimmers, which should be positioned to secure the shortest leads.

Don't be tempted to mount the coil in any other plane or position, otherwise you will be faced with a problem of hum pickup and the possible need for elaborate magnetic shielding.

Adjustment of the whistle filter will be greatly simplified if access can be had to an audio signal generator. The procedure is as follows:

Set the audio generator to 10KC and connect its output between chassis and

An underneath view of the Program Source chassis, with all the options installed. The slide type wavechange switch nestles in the space left for it last month, underneath the tuning gang. The drive system is readily apparent. The whistle filter stage is to the left of this, with the associated wiring components on a 5-tag strip just above the audio output pot.



With the aid of this diagram and the explanatory matter in the text, readers should have no difficulty in duplicating the switch mechanism in the prototype tuner.

the IF transformer side of the .01 uF in the grid of the cathode follower.

If available, place an AC millivoltmeter between the audio output point and chassis, to indicate when a null has been obtained. An output meter or AC voltmeter across the output of the main amplifier will serve the same purpose.

With the tuner switched on, adjust the slug in the filter coil until a drop in output is noticed. Now adjust the 100K potentiometer until a further drop, considerable this time, is seen.

Recheck both adjustments for the deepest null.

The filter will be fully effective on actual heterodynes only if it is accurately centred on 10KC and the calibration of the average audio generator may not be sufficiently precise to guarantee that the requirement will have been satisfied.

Therefore, while the generator test will have verified operation of the filter and clarified the setting of the 100K potentiometer, it may be necessary to readjust the core slightly for maximum attenuation of actual heterodynes, all of which can be expected to be "spot on" 10KC.

If no audio generator is available, it will be necessary to seek the most obvious 10KC whistle, if necessary with the tuner set slightly to one side of the local station and with the amplifier treble control fully advanced. Set the potentiometer at about half travel and run

the core through its adjustment until the whistle appears to diminish.

Vary the pot setting for further attenuation of the whistle, then vary the core setting. It should be possible to achieve a condition where the whistle is rendered completely inaudible.

If no amount of adjustment appears to affect the whistle, it is possible that the filter circuit is not passing through 10KC. Try another pair of capacitors within the range .0047 to .0068 to see whether proper results can be obtained.

Now for the dual-wave facility.

From the very outset, this caused us the greatest worry because of the extra components and the layout problems involved.

It was at first envisaged that, in the dual-wave version, the wavechange switch would have to be mounted in the position normally allocated for the tuning spindle, the latter having to be moved into the central position.

We were not happy about either proposition (a) because of the long leads which would be necessary to the switch and (b) because of the extra problems of dial stringing. To add a possible further objection, rearrangement of the knobs would involve kit-sellers in another set of stringing instructions and obviate any chance of them getting by with a single decorative front panel.

The solution to our problems appeared when we ascertained that ample stocks were available of "Oak" six-pole slide switches, manufactured in this country by MSP—AWA. Mounting one of these under the tuning capacitor would clearly obviate long wiring runs, leaving only the problem of operating the slider from a knob on the front panel.

This could provide an exercise for any mechanical geniuses among our readers, but the system shown in the diagram is well within the capacity of the average hobbyist.

A piece of 1/2-inch brass rod passes through a suitable bearing in the front panel or, more simply, a neat-fitting 1/4in hole. At the other end, the rod runs in a bearing provided by a 1in hole in a flap turned up from the main section of the chassis.

The rod is retained very simply by drilling and tapping for an 1/8-inch



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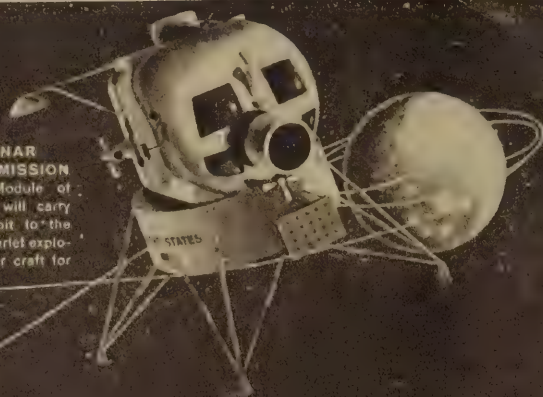
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Whitworth screw and providing an over-size washer.

A drop-arm can be fashioned very simply from a scrap of brass. A slot is cut, as shown, so that it will slip into two shallow sawcuts in the 4in rod, leaving just enough rod behind the sawcuts to run in the rear bearing. The drop-arm is sweated to the 4in shaft on the front side only, and clear of the rear bearing surface.

The drive to the switch slider can be fashioned very simply from scraps of 3/16in brass rod and tinplate. The length should be such that the drop-arm is vertical when the switch is halfway between the BC and SW positions.

A small cotter is needed to pin the drop-arm to the switch drive, or a brass tack with a spot of solder on the end to retain it in position. A couple of small screws (typically 8BA) serve to attach the arm to the switch slider.

With the switch mounted on 1/2-inch pillars underneath the tuning gang, the mechanical side of the job is done.

Nothing to it!

The short-wave coils themselves gave some cause for concern. At one time, it was possible to take one's pick of several brands but the position now is a good deal more vague. One brand we saw represented a rather impractical heirloom from the past. Another manufacturer expressed interest in providing suitable coils but failed to make good the intention.

The ones we actually used are "Aegis" brand intended for the 16-50 metre band. They are designed for push-fit mounting into 5/16in holes and have flying leads for connection into circuit.

To use these coils involved patching the chassis to provide the holes for mounting and leads, instead of the rectangular cutouts originally planned. The above-chassis photograph shows the coils in position, the oscillator coil in the front corner and the aerial coil just near the 6AE8 converter.

TRIMMER CAPACITORS

The trimmers — small rectangular Ducon types — fit up under the centre rectangular cutout, similar to the broadcast band trimmers. They are held in place by a strap of copper wire soldered across the centre of the assembly and anchored to chassis earth points.

To wire the switch and coils, it will be necessary to follow the circuit diagram carefully, along with the connection data for the coils.

Special care is needed with the rather frail leads provided on the short-wave coils. If they need to be extended, use a single strand from hook-up wire and insulate with the softest sleeving you can get your hands on.

For the guidance of constructors, we have sketched the sequence of contacts used on the switch in our prototype chassis. This involves four of the six poles on the switch, leaving two vacant.

One of these has been used to introduce an extra resistor in series with the earth return of the audio output pot. Introduction of the resistor allows a larger proportion of the audio signal to reach the amplifier, effectively increasing the gain of the system on short-waves. A suggested value for the resistor is 100K.

If the strength of short-wave stations should be such as to threaten overload

(Continued on Page 158)

The transmitter matches, in appearance, our "Amateur Band Ten" receiver and uses the same case and front panel.



5-BAND DSB TRANSMITTER

In this article we present a DSB transmitter which may well solve the problem of those amateurs who would like a sideband signal but lack the technical facilities or money needed to produce a full SSB rig. The unit produces a sideband signal which is quite easily resolved on even simple equipment. In addition, it can be operated in the AM or CW modes with equal facility.

This transmitter was designed as a companion unit to the "Amateur Band Ten" and "Communications Eight" receivers described in the January, February, March and May issues of this year. Since the frequency generating portion of the transmitter is available ready wired and calibrated, it represents a very easy method of obtaining a sideband type signal at reasonable cost.

In justifying the presentation of this transmitter, perhaps we should state, right at the outset, that we will not "buy an argument" on the advantages of SSB over DSB. There is no question in our minds on which is the superior mode of transmission. There must, however, be many amateurs who lack the skill, time or money to construct a "full blown" SSB rig but who would, none the less, like a transmitter which allows them to take their place in a sideband net.

In our "on the air" tests of the transmitter, we found very few stations who immediately identified the transmissions as being DSB. The majority thought it was an SSB transmission and only "found" the other sideband when it was brought to their attention. All the stations worked found our signal easy to tune, perfectly stable, of good audio quality and, in all respects, a perfectly acceptable "sideband" signal. The carrier suppression was such that a station at 500 yards distance from the transmitter was unable to detect any sign of carrier.

Just as the design of the "Communications Eight" and "Amateur Band Ten" receivers was influenced by the availability of suitable factory-made front-end units, so the design of this transmitter was largely influenced by the release of a new Geloso transmitter VFO front-end unit, intended primarily for ordinary AM transmitters.

This unit features a VFO which runs,

at all times, on approximately 5MC; the output from this is heterodyned with suitable crystal oscillators to produce a signal on each of the amateur bands between 80 and 10 metres. The overall stability of the unit is as good as the 5MC VFO and this, being temperature compensated and mechanically sound, is more than adequate. Actual measurements showed the unit to drift approximately 1.5KC during a 15-minute warm-up period, after which the drift was less than 400 cycles an hour.

The output of the VFO/mixer is coupled into a 6CL6 driver with band-switched tuned circuits and the whole unit comes complete with a dial which is accurately calibrated in 10KC increments.

It is, in fact, the availability of this unit which makes the construction of a DSB transmitter a worthwhile project.

sary to perform a few small modifications on its original circuit and, for this reason, we have shown the circuit of the unit in full, a departure from our usual practice.

The first of these modifications concerns the HT feed arrangements. In the unit as supplied by Geloso, it is intended that a common HT line should feed the unit and that this should be interrupted when the transmitter is not operative. This arrangement, although adequate for AM operation, leaves something to be desired for sideband operation where good frequency stability is essential.

The VFO tuned circuits in this unit are temperature-compensated but, even so, a change in operating temperatures by the alternate application and removal of HT feed will cause small deviations in output frequency which would be an-

By Keith Jeffcoat

If one had to start from scratch and build a VFO and bandswitched drivers, it would be almost as simple to build a complete SSB transmitter and be done with it.

With the Geloso unit as a starting point it is only necessary to add a balanced modulator, simple audio amplifier and a power supply to produce a complete DSB transmitter and, in essence, that is exactly what we have done.

Perhaps, at this stage, we might take a look at the main circuit diagram and see how the transmitter has been evolved.

The particular Geloso VFO we have used, their model 4/105, was intended to be used in an AM transmitter to drive a single 6146 or 807 valve. In order to use this VFO for DSB work it is neces-

noying when operating in, say, a sideband net.

In order to overcome this potential problem we have separated the HT feed to the crystal oscillator in the unit, so that this is the only portion of the unit which has its HT interrupted when the transmitter is inoperative.

Removing the H.T. from the crystal oscillator ensures that the unit will not produce an output signal which interferes with reception. At the same time, the H.T. constantly applied to the other stages allows them to quickly reach and retain their normal operating temperature. Since these stages, in particular the 6CL6 driver/output stage, are fixed biased, their operating conditions are not affected by the removal of HT to the crystal oscillator.

To effect this modification, it is only

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Output is over 20V into open circuit, 160mW into 600 ohms.

Transistorised, capacitance-tuned RC Wien-bridge oscillator and power supply are completely contained in a 8" x 6" x 8" package.

These features make the new GR Type 1310-A Oscillator an outstanding instrument for day-to-day applications. But, what definitely puts this oscillator in a class by itself is an entirely new feature by which its frequency can be synchronised with an external signal. Also, the oscillator can itself be used to furnish a sync signal to other equipment. Thanks to this sync provision, unique in an inexpensive oscillator, the new Type 1310 has a much wider range of application than the ordinary oscillator.

In a nutshell, the 1310-A now brings the small size, mechanical ruggedness and reliability of transistorised circuitry to a wide-range, general purpose instrument. It offers all the benefits you expect in a modern, two-feedback-path RC oscillator including high accuracy and infinite resolution of variable capacitance tuning — plus the new frequency-synchronisation provision—all at a surprisingly low price.

Here are Some Uses For Oscillator Synchronisation:

as a tracking narrow-band filter to reduce hum noise, and distortion in a signal; a source of amplitude-modulated signals; an automatic phase-controlled oscillator to reduce frequency modulation or jitter; a single-frequency leveling amplifier; a phase-locked, sinusoidal frequency multiplier; a phase shifter; a narrow-band isolation amplifier; an amplitude-modulation filter.



FREQUENCY

Accuracy: $\pm 2\%$ of reading.

Stability: Typical drift after warmup.

0.001% short term (1 min.) at 1 kc/s

Synchronisation: Jack provided for external phase-locking signal. Locking range is about $\pm 3\%$ for 1-V rms, input reference signal over entire 2-c to 2-Mc range. Locking ranges up to 40% can be used.

OUTPUT

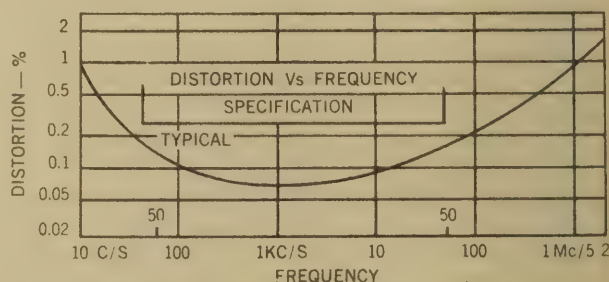
Voltage: Over 20V, open circuit; continuously adjustable attenuator (approximately 50 dB).

Amplitude Stability: Typical drift after warmup 0.02% short term (1 min.).

impedance: 600 ohms.

Distortion: As indicated. Hum less than 0.02% independent of attenuator setting.

Synchronisation: High-impedance, constant-amplitude 0, 8, V, rms, output for use with oscilloscope, counter or other oscillators.



GENERAL

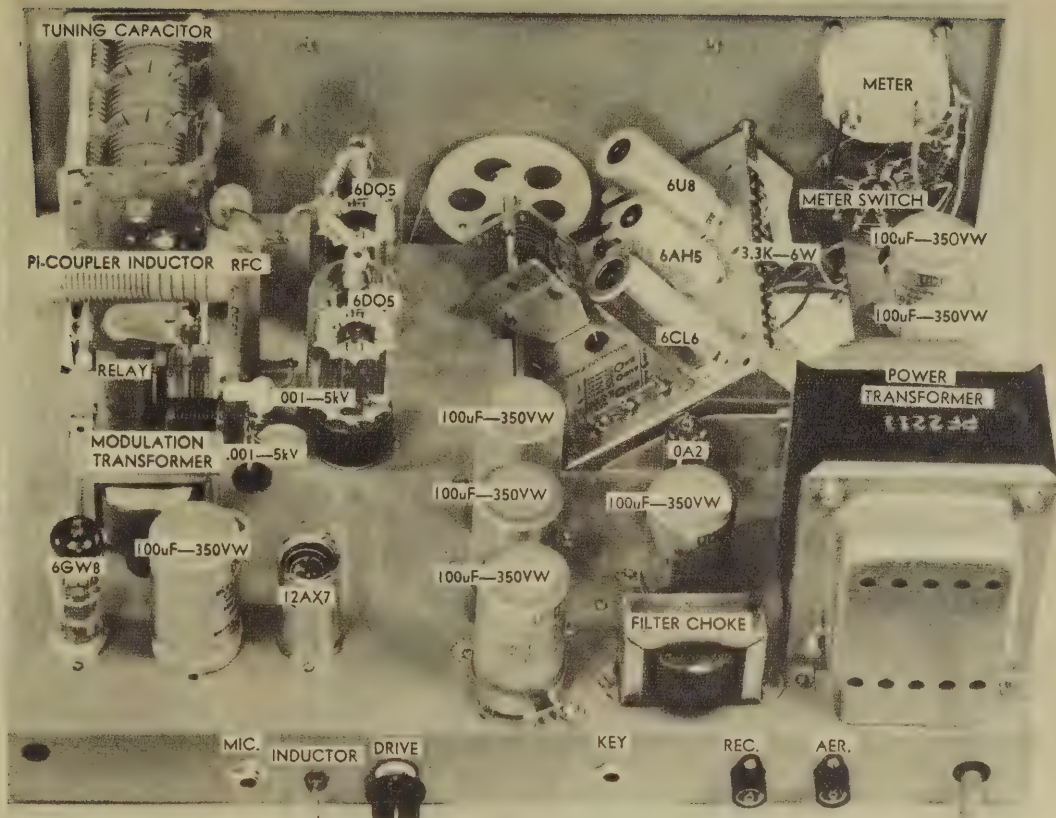
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Note the angle at which we found it necessary to mount the Gelo unit. This looks unweildy but is, in fact, no more difficult than mounting the unit in the manner intended by the manufacturers.

necessary to locate the 22K resistor connected to pin 3 of the 6U8 and remove one end of this resistor from pin 6 of the terminal board and reconnect it to pin 4 of the terminal board.

The second modification involves the grid bias circuit of the 6CL6 driver stage.

In the original Gelo unit, a negative 50 volts is applied to pin 11 of the terminal strip. This is applied to a 4,700 ohm and 470 ohm resistive divider combination to provide a fixed bias of 5 volts for the grid of the 6CL6.

We modified this arrangement by locating the 470 ohm resistor in the divider, lifting one end of it from earth and attaching it to pin 12 of the terminal board. A .001uF ceramic capacitor is then wired between pin 12 of the board and earth.

As can be seen from the circuit, this allows us to apply blocking bias to the grid of this valve, as well as the grids of the 6DQ5s for the purpose of providing effective CW keying of the transmitter.

The third modification involves the output circuit of the 6CL6.

Gelo intended the tuned circuits attached to switch wafers 4R and 4F to be used as part of the grid circuit of a single 6146 final amplifier. To this end they bypassed the "bottom" end of these tuned circuits to ground with a .0047uF capacitor.

The type final amplifier/balanced modulator we have used demands that either the plates of the valves should be operated in push-pull, in which case the signal must be fed to the grids in parallel, or the grids may be fed with a signal in push-pull, in which case the plates must be parallel-connected.

If we had left the Gelo unit as originally constructed, we could have used it to drive the grids in parallel, but this would have necessitated a push-

pull connection of the plates, with all its disadvantages of complicated band-switching, link coupling, etc.

We decided that, in the interests of harmonic suppression and simplified bandswitching, the plates of the 6DQ5s must work into a pi-coupled output circuit. This left us with the necessity to provide push-pull drive for the grids of the two valves.

We accomplished this by removing the .0047uF capacitor attached to the tuned circuits on wafer 4F of the Gelo unit and substituting, in its place, a 3/30pF trimmer capacitor. When this capacitor is adjusted so that the capacitance to ground from both ends of the tuned circuits is equal, the result is a balanced output which can be used to feed the grids of the 6DQ5s.

The abovementioned .0047uF capacitor is located between the 20 and 15 metre coils at the rear of the Gelo unit and is somewhat hard to get at. A very fine-pointed soldering iron is necessary if the coils and their connections are not to be damaged in the process.

The last modification of the Gelo unit, if such it could be called, consists of adding some capacitance across certain of the 6CL6 plate coils so that they can be resonated properly. These additional capacitors are clearly shown in our main circuit diagram.

The signal from the Gelo unit is capacitively coupled to the grids of the 6DQ5s. The DC return for each of these grids is via an RF choke, a 10K bias resistor, a 100-ohm resistor and thence to a common connection which passes through the transmit/receive relay and the key jack to earth.

This common connection on the grid returns is also connected, through a 27K resistor, to the 100-volt negative bias supply so that cut-off bias is applied to these valves when the relay is in the receive position. When the relay is

actuated, the fixed bias is removed and the valves become self biased, developed across the 10K ohm resistors, from grid current produced by the RF drive from the 6CL6.

The cathodes of the 6DQ5s are connected to the AM/DSB switch. This places both cathodes in parallel, then to ground through the metering resistors. When DSB operation is desired it open-circuits the cathode of the lower 6DQ5 when AM operation is the desired mode.

Taking one of the valves out of the DC circuit will, of course, unbalance the final so that the carrier signal will pass through the remaining valve in the normal manner of a single-ended stage. The capacitive coupling which remains through the lower 6DQ5 makes neutralisation of the final amplifier unnecessary.

Note that the 6DQ5s have two cathode pins and that each of these must be separately bypassed to earth to ensure stable operation of the valve. Note, also, that the cathode capacitors on the lower 6DQ5 have a high voltage rating.

This latter is essential because the cathode of this valve will rise to almost the full HT value when the AM/DSB switch is in the AM position.

The plates of the 6DQ5s are, as previously mentioned, parallel-connected and coupled to the high voltage supply through a dual RF choke arrangement. Each plate is fitted with a standard form of parasitic suppressor and the junction of these is capacitively connected to the Gelo pi-coupler network used in the output.

The tuning and loading capacitors plus the bandswitched inductor which make up this network and the special RF choke which feeds HT to the plates can be obtained as a complete kitset from Gelo. The availability of this



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kit removes much of the hard work from the final, since the particular unit chosen provides an optimum impedance match for the valves to feed a non-inductive 70-ohm aerial.

The screens of the 6DQ5s are directly connected to the secondary of the push-pull modulation transformer. The centre tap of this transformer is connected to the second half of the AM/DSB switch.

Note that the screens are also brought out to two pins on each valve socket and that each of these pins must be separately bypassed to earth.

For DSB operation, the centre tap of the modulation transformer is returned through a resistive divider to the negative bias line. The 50 volts (approx.) negative thus applied to the screens ensures that the standing current of the final valves is reduced to a reasonable figure (around 15 to 20mA) and also assists in keeping crossover distortion, during modulation, to a minimum value.

For AM operation the screen of the operative valve must be positively biased to a voltage which permits the optimum loaded plated current to be drawn. Since the exact screen voltage required varies, depending on how much grid drive is available and the loading of the antenna to the final, we have arranged the circuit such that the screen voltage is continuously variable from zero to 250 volts, the potential of the minor HT supply.

The manner in which this control is adjusted for optimum operation of the transmitter in either the CW or AM mode will be discussed fully at a later stage in the article.

If a DSB transmitter is to produce an acceptable signal, much depends on the frequency response and other characteristics of the modulator.

For general audio clarity and tuning ease, a DSB signal should contain little, if anything, of the audio frequencies below about 300 cps. Then, in order to retain the total transmitted bandwidth within acceptable limits, the audio frequencies above 3 KC should be similarly attenuated.

In our modulator design we have taken steps to ensure that the frequency response is within the quoted limits.

The 12AX7 preamplifier is wired as a cathode follower/grounded grid stage with the signal cathode coupled through a "pi" type filter network. The component values in this network are chosen to begin attenuation of the input signal at around 2.5 KC.

In the remainder of the modulator's stages we have carefully chosen the values of coupling and cathode bypass capacitors to attenuate the low frequency end of the audio spectrum. These values cause the response to begin rolling off at around 400 cps. and it is well "down the drain" at 200-300 cps.

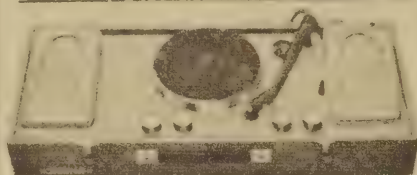
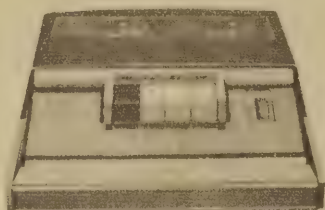
The power output requirements of the

In a departure from our normal practice we have shown, on our main circuit, the full wiring of the Geloso VFO unit. Note, however, that certain of the wiring shown for this unit is in the modified form we found necessary to make the unit suitable for DSB service. In this section, component values are only shown on those portions of the circuit which had to be modified.

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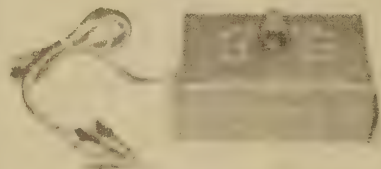
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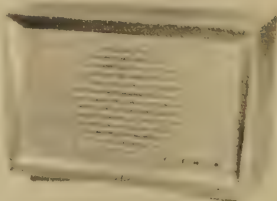
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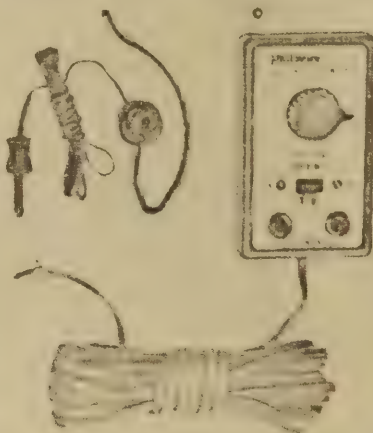
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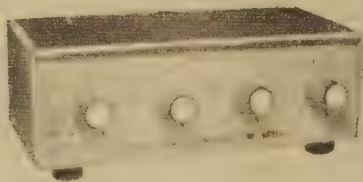


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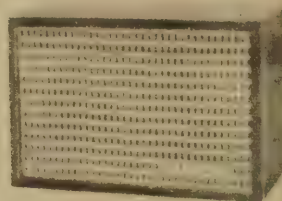
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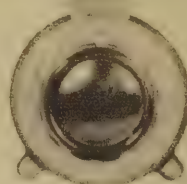
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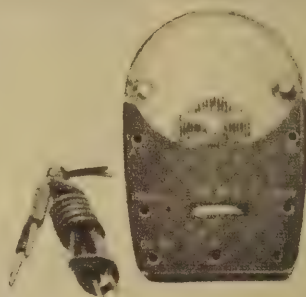
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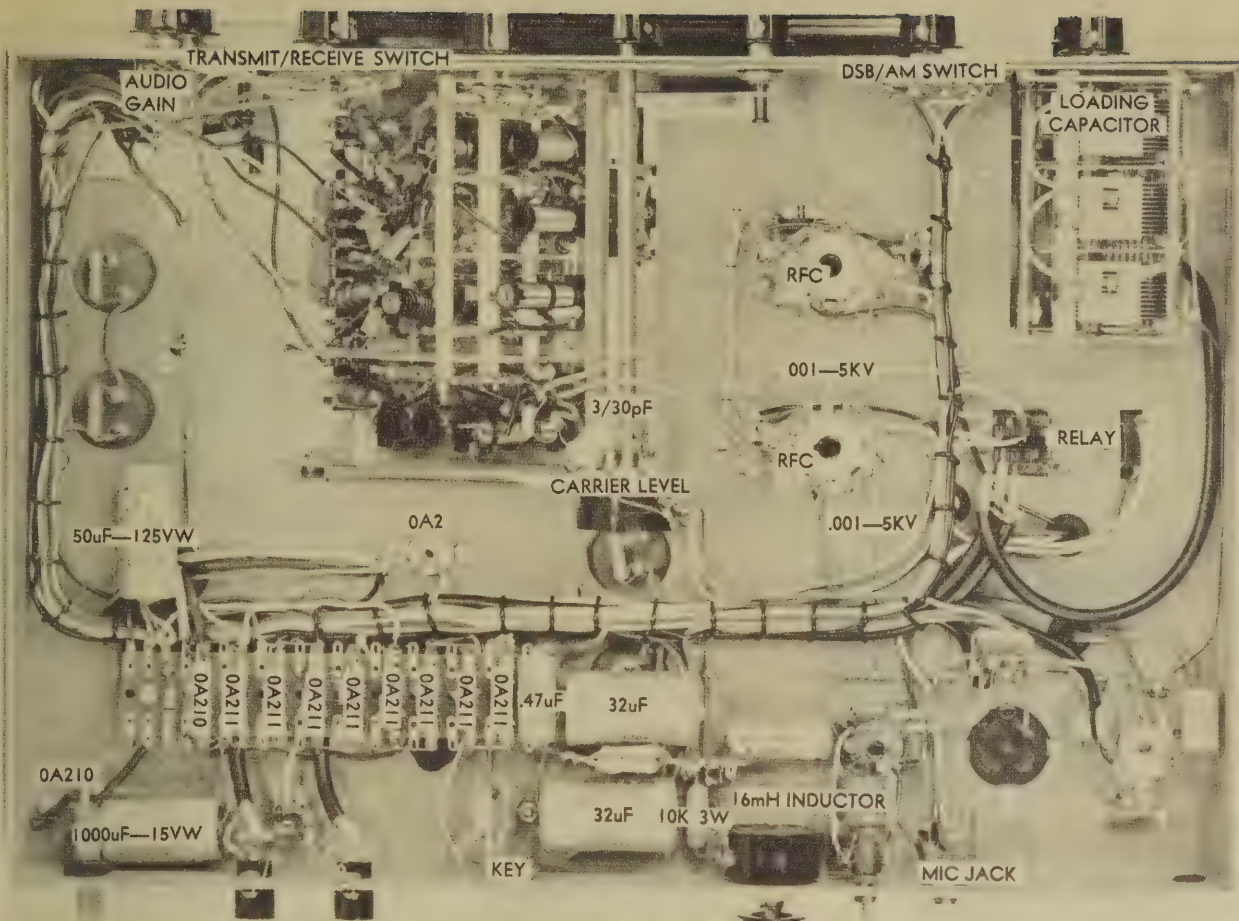
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Our coded underchassis view of the transmitter should assist in the wiring of the unit. Note the position of the carrier level control at the rear of the Geloso unit and the tagboard terminating the rectifier diodes and other wiring of the power supply.

modulator are not high—about two watts are adequate—but a sufficiently high audio voltage must be produced to adequately drive the screens of the output valves.

The modulation transformer we used is one especially designed by a local company for the requirements of DSB transmitters. It has a primary impedance of 5,000 ohms, primary to secondary turns ratio of 1 to 3, is capable of handling 5 watts of audio power and has a deliberately restricted audio frequency response of 100 cps. to 5 KC.

With the 6GW8 running at 2 watts input this transformer will produce 300 volts rms across the whole of its secondary and this is more than sufficient to fully drive the 6DQ5s. Those who do not wish to make use of this special transformer could substitute a standard power transformer having a 240 volt primary winding and a 385 volt per side secondary winding, the latter connected to the screens of the 6DQ5s and the primary used as a load for the 6WG8.

The metering circuit uses a standard 0.1 mA movement which, with suitable series and shunt resistors, allows one to measure the grid current to each of the 6DQ5s, the common cathode current to these valves and the RF voltage at the aerial connector.

The meter gives a full scale reading of 12.5 milliamps in the grid position and 250 milliamps in the cathode current position. The values in the RF metering section are chosen to give a two-thirds of full scale reading on average output from the transmitter into a 70 ohm aerial load.

The power supply of the transmitter utilises a special transformer already manufactured by a local company

(Ferguson) and originally designed for use with several of the commercial SSB transceivers being imported into this country. There are other transformers available which will meet the filament and HT specifications of this unit but none has the special bias voltage winding which this particular transformer has. Other manufacturers may choose to make a suitable component available.

The 6DQ5s require at least 800 volts HT for proper sideband operation and this is developed through a bridge rectifier connected across the whole of the 295 volts per side secondary winding. Each of the silicon diodes in this bridge has a 220K 1-watt resistor across it to equalise reverse voltage across the series-connected diodes.

Although the rms voltage from this secondary winding is only 600 volts, the large bank of capacitors used (66uF at a working voltage of 1050 volts) allows the final HT to closely approach the peak value of the sine wave and, in fact, the HT voltage under load conditions will be just slightly in excess of the 800-volt mark.

Each of the half-dozen capacitors on the HT line has a 220K resistor across it to equalise voltage distribution across the units.

From the centre tap of the HT winding, and using those diodes in the bridge which are connected to earth, we have a full-wave rectifier system which produces the 250 volts needed for the minor HT supply.

The filter choke used in this supply line is nominally a 1-henry unit rated

at 285 milliamps maximum current flow. At the current the transmitter draws through it, however, it has a much higher effective inductance and, with a .47uF capacitor connected across it, resonates at close to 100 cps. This helps to eliminate ripple on the HT line. With different brands of choke, it may be necessary to vary the shunt capacitor to achieve resonance at 100cps and minimum hum level.

The bias voltage winding is connected to a straight half-wave rectifier and a single 50uF capacitor, there being no need for extensive filtering on this line.

A DC voltage to operate the transmit/receive relay is developed from one of the 6.3 volt filament windings with which the transformer is equipped. If the relay you wish to use requires 12 volts DC for its operation, a simple voltage double arrangement could be used in place of the system we used.

It will be noticed that each of the 6.3 volt filament windings on the transformer has a 4 ampere rating. Nothing less than this will suffice since the 6DQ5s draw 2.5 amps each!

The transmitter is constructed on the same 16in by 11 in by 2in chassis and 16 in by 7½in front panel as was used for the "Communications Eight" and "Amateur Band Ten" receivers. This metal work has now become a standard size and should be easily available to the majority of intending constructors. For those requiring them, chassis and panel blueprints are available from our query service department at a nominal cost of 5/-each.

22 RANGE

GENERAL PURPOSE MULTIMETER

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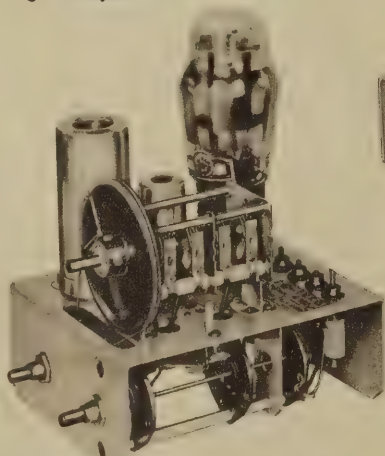
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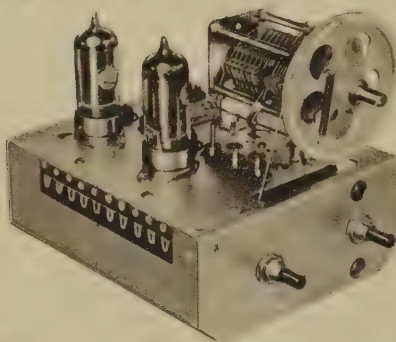


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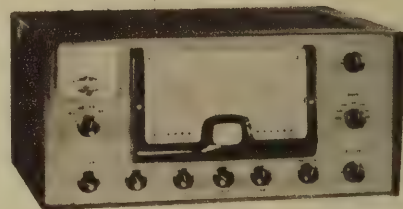


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The Geloso unit, as supplied, is intended for use with a front panel of at least 10in in height. The limited panel height of our metalwork makes it necessary to mount the unit at an angle of approximately 45 degrees to the chassis in order to accommodate the rather largish dials supplied with the units.

This presents no special difficulties, however, and apart from the fact that the dial drive must be restrung, the unit is no harder to mount this way than in the manner for which it was originally intended. The internal modifications, described earlier, are best carried out on the Geloso unit before it is mounted in the chassis.

The layout of the rest of the components, particularly the 6DQ5s and the pi-coupler, is more or less dictated by the position the Geloso unit must occupy in the chassis.

To reduce the length of the grid leads to the 6DQ5s, they are mounted as close as possible to the VFO and, for similar reasons, the components of the pi-coupler are mounted immediately adjacent to these valves. The mounting of the pi-coupler components in a straight line on the panel was necessitated by the limited panel space available after the Geloso dial had been accommodated.

This arrangement works very well in practice, however, as shown by the fact that the pi-coupler tunes and loads perfectly on all bands and with the inductance set to the appropriate tap positions as quoted by the manufacturer.

The transmit/receive relay is mounted in a convenient position immediately behind the pi-coupler; the modulation transformer and modulator valves are mounted behind this again and in that corner of the chassis which is furthest from the power transformer. This serves the dual purpose of keeping the modulation transformer close to the valves it is intended to serve and, at the same time, reduces the possibility of hum fields penetrating the audio system.

FILTER CAPACITORS

The other components of the power supply, filter choke, capacitors, voltage regulator etc., are positioned in no special manner except to occupy chassis space as economically as possible.

Prior to mounting the electrolytics it is essential that several layers of plastic tape should be wrapped around the case under the position occupied by the clamp. The series connection of these electrolytics will place the case of some units as much as 600 volts above ground and they must therefore be well insulated from their grounded clamps.

In purchasing the electrolytics it would be as well to specify, for all units, the type which has an insulated sleeving over the entire surface of the case. It will still be necessary to wrap insulating tape around the bottom of the case but the totally insulated case may, at some stage, prevent the user from receiving a nasty shock if adjustments are being made on the unit while the power is applied.

In positioning the remainder of the front panel controls, we tried to produce a pleasing appearance for the finished product, although this sometimes meant placing a control some distance from that portion of the circuit to which

it was electrically connected. A typical example of this is the audio gain control, which is placed in that corner of the panel which is furthest from the audio amplifier.

We could not have placed this control close to the amplifier, however, because that section of the panel is occupied, out of necessity, by the pi-coupler controls and the AM/DSB switch, the latter needing short and direct connections to the cathodes of the 6DQ5s and the modulation transformer.

The leads to the audio gain control are run in shielded wire which, despite the fact that it is laced in with all the power wiring, resulted in no hum or instability problems for the amplifier.

The meter is placed in the only remaining section of front panel large enough to accommodate it and the metering switch is, logically enough, directly beneath the meter.

The leads from these two components must, once again, be run in the wiring brace and right around to the other side of the chassis. However, since these leads are well bypassed to earth and carry only voltages from very low impedance sources, they present no prob-

blems other than the extra yard or so of wire expended.

The carrier level control is placed between the Geloso bandswitch and tuning controls. Because of the manner in which the Geloso unit had to be mounted, there was not sufficient room to mount this control directly on the panel in what would be the normal manner. It had, instead, to be mounted on a bracket at the rear of the Geloso unit and coupled to the front panel knob through an extension shaft.

On the rear apron of the chassis, reading from left to right in the photograph, are the microphone input jack and the filter inductor, the Geloso drive control, key jack, coax connectors for the receiver and the main aerial and the power cord inlet.

The majority of these components are close to that portion of the circuit to which they are connected, the exceptions being the two coax connectors. These two might have been placed before the microphone jack, where they would have short leads to the change-over relay, but we placed them where they are to avoid the risk of RF getting into the audio section.

PARTS LIST

RESISTORS

- 2 10 ohm—1 watt.
- 2 100 ohm—1 watt.
- 2 100 ohm— $\frac{1}{2}$ watt.
- 1 220 ohm—1 watt.
- 2 1K— $\frac{1}{2}$ watt.
- 1 1.2K— $\frac{1}{2}$ watt.
- 1 2.7K— $\frac{1}{2}$ watt.
- 1 3.3K—6 watt.
- 1 4.7K— $\frac{1}{2}$ watt.
- 1 5.6K—1 watt.
- 9 10K— $\frac{1}{2}$ watt.
- 1 10K—3 watt.
- 1 20K—2 watt potentiometer.
- 2 27K— $\frac{1}{2}$ watt.
- 1 35K—6 watt.
- 1 50K—2 watt potentiometer.
- 1 220K— $\frac{1}{2}$ watt.
- 14 220K—1 watt.
- 1 500K potentiometer.
- 2 1 megohm— $\frac{1}{2}$ watt.

CAPACITORS

- 1 15pF—NPO ceramic.
- 2 22pF—NPO ceramic.
- 1 3/30pF trimmer.
- 1 100pF—AY ceramic.
- 14 .001uF—600 volt ceramic.
- 5 .001uF—5kV ceramic.
- 2 .1uF—30 volt plastic.
- 1 .22uF—30 volt plastic.
- 1 .47uF—125 volt plastic.
- 1 3uF—25 volt electrolytic.
- 1 8uF—275 volt electrolytic.
- 2 32uF—500 volt electrolytics.
- 1 50uF—125 volt electrolytic.
- 7 100uF—350 volt electrolytics.
- 1 1000uF—15 volt electrolytic.
- 1 23/209pF tuning capacitor — Geloso type 774.
- 1 32/1415pF tuning capacitor — Geloso type 774.
- 1 N4/113 Geloso pi-coupler inductor unit.
- 1 16mH inductor — Telecomponents type 7703.
- 1 Special RFC — Geloso type N17634.
- 3 2.5mH RF chokes.
- 1 OA91 germanium diode.
- 8 OA211 silicon diodes.

- 2 OA210 silicon diodes.
- 2 6DQ5 valves.
- 1 6GW8 valve.
- 1 12AX7 valve.
- 1 OA2 valve.
- 1 6U8 valve.
- 1 6AH6 valve.
- 1 6CL6 valve.
- 1 Special power transformer PF2211—295 volts per side at 275 milliamps, 100 volts at 25 milliamps, 6.3 volts at 4 amperes, 6.3 volts at 4 amperes.
- 1 Filter choke—1 henry at 285 milliamps.
- 1 Modulation transformer MT451—5K ohms primary impedance with 1 to 3 primary to secondary turns ratio.
- 1 0-1mA, 2 $\frac{1}{2}$ " square panel mounting meter.
- 1 Relay—6 volt DC coil with one set of changeover and two sets of make contacts.
- 1 2-pole, 2-position switch.
- 1 2-pole, 3-position switch.
- 1 2-pole, 4-position switch.
- 1 2-lug tagstrip.
- 4 3-lug tagstrip.
- 1 4-lug tagstrip.
- 2 5-lug tagstrips.
- 1 42-lug section of terminal board.
- 2 Coax sockets.
- 1 Key jacks—shorting type.
- 1 Microphone jack — ring, tip, sleeve type.
- 2 Octal valve sockets.
- 2 9-pin valve sockets.
- 1 7-pin valve socket.
- 11 Knobs of suitable type.
- Suitable chassis, front panel and case (see text).
- Geloso G4/105 VFO unit.
- 4 $\frac{3}{8}$ " rubber grommets.
- 1 $\frac{3}{4}$ " rubber grommet.
- 1 5 $\frac{1}{2}$ " length of $\frac{1}{4}$ " extension shaft.
- 1 Double ended coupling piece for $\frac{1}{4}$ " shaft.
- Hookup wire, tinned copper wire, shielded wire, coax cable, nuts, bolts, washers, etc.

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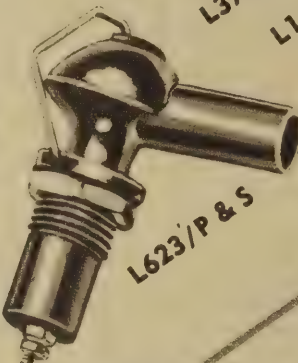
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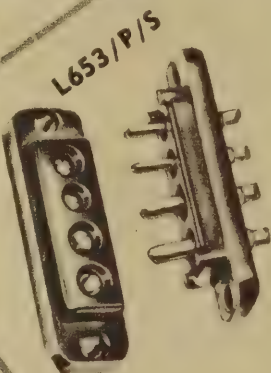
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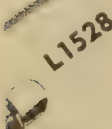
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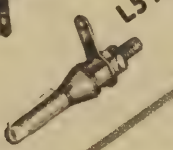
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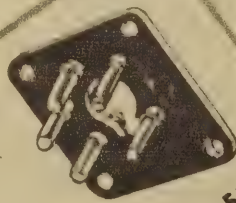
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SINGLE POLE

UNITORS

DOUBLE SINGLE POLE

Once the major components have been bolted to the chassis, the job of wiring could be commenced and some time and effort may be saved if this is accomplished in the following sequence:

First, if the chassis used is an aluminium type, a common earth bond of 18-gauge tinned copper wire should be run between all valve sockets, earth lugs, etc. A little time spent in making a good earth system may save a lot of headaches later on.

With a common earth bonding established, the next step might be the earthing of all necessary valve socket pins and other major components which, on the circuit, have an earth connection shown. Note that, at this stage, none of the minor components such as resistors, capacitors or diodes should be wired into the unit.

The next step should be the wiring in of all basic connecting leads such as filament and HT runs, coax. cable to the relay, shielded leads to the audio gain control, metering leads, etc. In our prototype unit, and we suggest you follow the same procedure, we ran all these leads along a common path which can be clearly seen in our under-chassis view of the unit. Once the full complement of these leads has been installed they can be laced together for the sake of rigidity and an attractive appearance of the finished product.

In making up this wiring brace we suggest you start at the terminal board of the Geloso unit and work methodically through the circuit, considering carefully each connection and whether or not it could logically be one of the wires in the brace. If possible, make use of a variety of wire colours in this wiring, since this will aid in the later identification of leads which, for the moment, can only be terminated at one of their ends.

Be sure to run filament leads for the 6DQ5s which are separate from those to the Geloso unit and the 6GW8/12AX7 combination. The 6DQ5s draw a lot of filament current (2.5 amperes apiece) and their supply leads should not be overburdened with current drawn by other valves in the line.

WIRING FORM

When you think you have included every lead necessary in the wiring form, check over the circuit once again as otherwise you might find, as we did, that there were four or five leads you had completely forgotten.

Start your lacing of the leads at the DSB/AM switch and work around the chassis to the point where the leads duck through to the metering switch and the Geloso terminal board. Suitable lacing materials are dial cord or 2 millimetre spaghetti tubing but, if these are not easily available, a piece of well-waxed ordinary household string will do the job quite nicely.

The next step is the wiring in of the minor components and this should be commenced by wiring across each of the chassis-mounted electrolytics a 220K, 1 watt resistor. Now solder 8, 220K, 1 watt resistors to the 42-lug terminal board and connect across each of these resistors an OA211 power diode.

Also terminated on this board should be the .47uF capacitor which resonates

the filter, the power diode for the relay supply, one end of the diode in the bias supply, the two 6.3 volt filament connections, the 10K and 27K resistors which connect between the bias line and the transmit/receive relay and the bias line to pin 11 of the Geloso terminal board; finally, the primary connections of the transformer, these latter being connected to those 4 lugs of the terminal board which is nearest to the corner of the chassis.

Now wire in the two 32uF electrolytics of the minor HT supply and the 35K, 6-watt resistor that acts as a bleed for this supply. This bleed resistor may be a single unit of the appropriate rating or, as in our case, a number of resistors connected in parallel to achieve the required resistance and wattage rating.

The next step might be the wiring in of the various components attached to the 12AX7 and 6GW8 in the audio system. Keep the leads of these components as short and direct as possible, particularly those of the 10K parasitic suppressor in the grid of the 6GW8.

If the microphone jack and filter inductor have been correctly positioned, they should only need a lead length of about 1 1/2 in to connect them to the appropriate pins on the 12AX7 socket and these can be plain, unshielded leads.

It is, incidentally, important that the filter inductor be placed in the position we have shown in our layout. In this position there is a minimum of coupling between the field of the inductor and that of the modulation transformer.

This inductor is a standard TV width coil (Telecomponents type 7703) which will supply the required 16mH of inductance with its slug wound almost right out of the winding.

The next step in the wiring might be the placing in of the bypass capacitors on the sockets of the 6DQ5s and the wiring in of the components in the grid circuit of these two valves. These latter components are mounted on two 5-lug tagstrips mounted under the socket bolts nearest the edge of the Geloso unit.

The tuning and loading capacitors of the pi-coupler unit, as supplied by Geloso, are both three-gang units and the individual gang sections in each unit must be parallel connected with short lengths of wire. Connect these capacitors to the pi-coupler inductor and connect a 1000pF, 5kV ceramic capacitor between the tuning capacitor and the top of the RF choke which feeds the plates of the 6DQ5s.

VARIABLE CAPACITORS

The plate of each 6DQ5 is connected to this RF choke through a parasitic suppressor consisting of a 100-ohm, 1-watt carbon resistor which has 9 turns of enamel or tinned copper wire wound on it. All of the connections between the 6DQ5 plates, the RF choke and the pi-coupler should be kept as short as possible if the unit is to tune and load properly on 28MC.

This just about completes the wiring of the transmitter and we shall now describe, briefly, how to test and align the completed unit.

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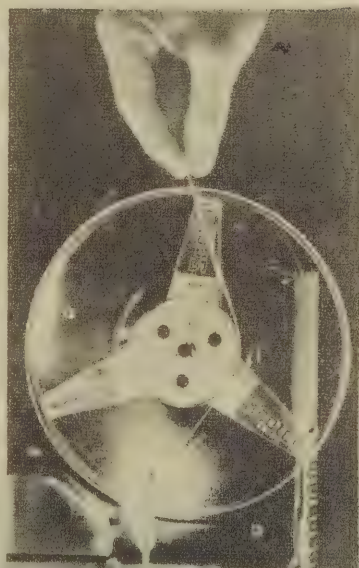
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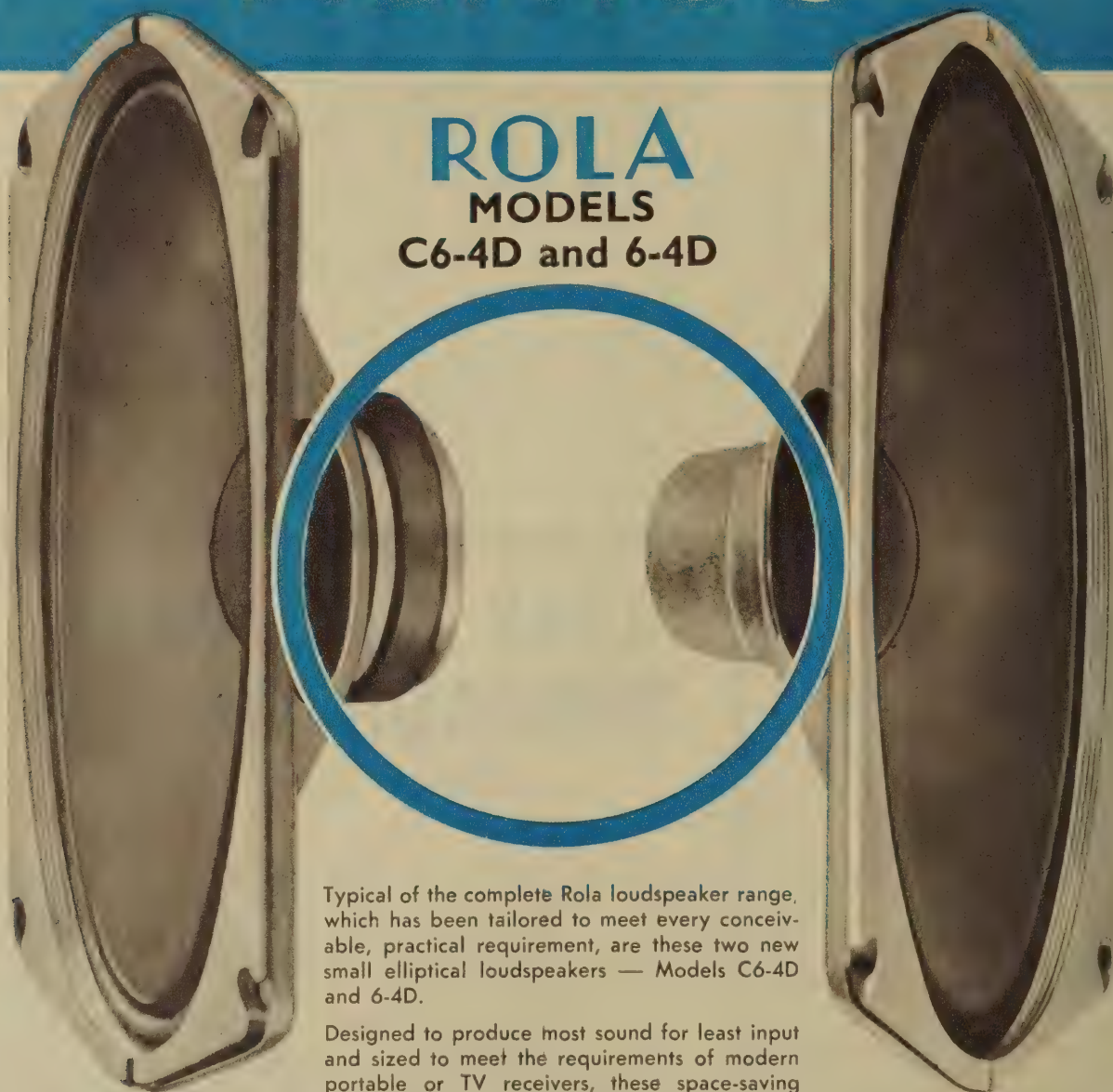
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Testing the DSB transmitter —

As a preliminary step we suggest that, before applying power to the unit, a resistance test be made between ground and the HT and bias connections at the power supply. The exact resistance obtained will vary with capacitor leakage but should be in the vicinity of 20K ohms. The thing to watch for, however, is a short or near short circuit on any of these lines.

With this check completed you could plug in the 6GW8 and the 12AX7 leaving, for the moment, all other valves out of the unit. Connect a 15K ohm 3-watt resistor between the screens of the 6DQ5s, set the AM/DSB switch to DSB, the function switch to OFF and plug the unit into the mains.

If an AC voltmeter is available, set it to read at least 300 volts and connect it across the 15K resistor. Turn the function switch to "receive" and advance the audio gain control to full on. Observe that there should be little if any reading on the AC voltmeter, this being an indication that the audio amplifier is not subject to hum or instability.

If a substantial reading is observed it will be necessary to identify the cause and, if an oscilloscope is not available, this might best be accomplished by connecting a pair of headphones, through a suitable dropping resistor, across the 15K ohm dummy load resistor.

The amplifier has a fair gain (40 millivolts input will produce full output) but it should be quite stable and hum-free if constructed according to our specifications. If instability exists, the most likely cause is coupling between the fields of the modulation transformer and the filter inductor.

This type of instability is readily identified by the fact that it produces, at the output, a pure sounding tone of approximately 2KC, the exact frequency being dependent on the setting of the filter inductor slug.

Once the amplifier has been checked out for hum and instability, an audio generator, if one is available, should be connected to the microphone jack and used to determine the frequency response of the unit. The response should roll off, quite steeply, below 300 cps on the low end and at about 2.5KC for the high end. If the high frequency roll-off is not as designed, adjustment of the filter inductor should put it right.

When the audio section has been checked out, unplug the unit from the mains, wait approximately 30 seconds and short both HT lines to ground. The next step is to plug in the remaining valves. The precaution of shorting out the HT line may prevent you from receiving a nasty shock when the plate caps are fitted to the 6DQ5s.

Temporarily disconnect from ground the 4.7K ohm resistor in the resistive divider connected to the DSB position of the mode switch. This will apply full negative bias to the screens of the 6DQ5s and prevent these valves from drawing excessive plate current during the alignment of the Geloso unit, which is the next job to be completed.

Now set the mode switch to DSB, the function switch to OFF, the metering switch to PA, turn the audio gain

control fully anti-clockwise, plug the unit back into the mains and carefully watch the meter. As the unit warms up the meter should read zero and remain at this reading. If the meter shows, by its reading, that the 6DQ5s are drawing plate current, there is a faulty connection in the grid bias line and the unit should be unplugged and this fault rectified before proceeding further.

If all appears in order, allow the unit about 10 minutes to warm up and turn the function switch to "transmit." This should cause the relay to close but produce little, if any, reading on the meter.

Set the Geloso bandswitch to 80 metres, turn the metering switch to "G2" set the Geloso dial to 3.6MC and adjust, for a peak reading on the meter, the slugs in the 80 metre tuned circuits connected to the grid and plate of the 6CL6. Note that the 80 and 40-metre coils are wound on the one former and the slugs for the 80-metre section are those accessible from the bottom of the unit. Note, also, that the coils in the grid section are as broad as the proverbial "barn door" in their adjustment.

Now switch the meter back and forth between the "G1" and "G2" positions and note whether the reading in both positions is identical. Any difference in the readings should be minimised by adjusting the 3/30pF trimmer previously installed between the 6CL6 plate circuits and ground.

When the two grid current readings are equal, re-peak the slug in the 6CL6 plate circuit and then go back and make any final small adjustment that may be necessary to the 3/30pF trimmer to once again balance the grid current. The adjustment of this trimmer should now be correct for all bands and it may be sealed with a dab of wax.

Turn the metering switch to "G2", put the Geloso bandswitch on 40 metres, set the dial to 7.1MC and proceed to align the 6CL6 plate and grid circuits for this band. Note that the slugs for these circuits are only accessible from the top of the Geloso chassis and that, to adjust them, your hand will be in close proximity to the plate caps of the 6DQ5s.

The 800 odd volts on these caps is backed by some 66uF of storage capacitance and can quite easily be lethal or, at the very least, will produce a violent muscular reaction you will remember for a long time. Might we suggest you don a pair of rubber gloves to perform this section of the alignment.

The slugs in the 20, 15 and 10-metre tuned circuits may be adjusted with a small screwdriver from the top of the Geloso chassis, or by the use of a non-metallic aligning tool inserted into the coils from the bottom of the chassis. The latter procedure is the safest and the one we recommend.

In adjusting the 20-metre coils the dial should be set to 14.25MC and to 21.2MC for adjustment of the 15-metre coils. When adjusting the 10-metre coils the dial should be set to 28.8MC and the bandswitch placed in the first of the two 10-metre positions.

Once these tuned circuits have all been adjusted to produce maximum grid drive the power may be removed from the unit and the 4.7K ohm screen bias resistor reconnected to earth.

Now connect a 70-ohm dummy load resistor to the antenna coax outlet and apply power to the unit. Set the mode switch to DSB, the meter switch to PA and turn the function switch to transmit. The meter should now show a standing current reading of 15 to 20 milliamps.

Turn both bandswitches to 80 metres, set the PA tuning and loading controls to about their mid-position and turn the mode switch to AM. Adjust the carrier level control to produce a plate current reading of approximately 50 milliamps and adjust the PA tuning for resonance as indicated by a dip in the plate current reading.

Turn the meter to the RF position and adjust the PA tuning and loading capacitors for a maximum reading on the meter. It would be wise, during this procedure, to keep a check on the plate current by switching the meter back and forth between the PA and RF positions. Never allow the plate current, at resonance, to remain for any period at a reading much greater than 50 milliamps. Keep it within this limit by the use of the carrier level control.

The above mentioned procedure sets the transmitter up for AM operation. With modulation, the average plate current reading will increase to around 65-70 milliamps.

On AM operation the transmitter will run around 50 watts input with approximately 25 of these watts being dissipated in the form of heat by the single valve used in this mode. This is, perhaps, not a very high power output but no attempt should be made to increase it by running the plate current at a figure higher than those quoted. The 6DQ5 anode "blushes" very readily and, if left in this condition for any period of time, will soon result in the destruction of the valve.

CURRENT FOR DSB

In DSB service the average plate current, as indicated by the meter, will be around the 70 to 100 milliamps mark but the peak current will be much greater and nearer the 175 milliamp mark. In order to achieve proper impedance matching to the 6DQ5's, the final must be resonated at somewhere near this plate current when operating in the DSB mode.

From previous discussion, however, we can see that the final cannot be left to run this amount of plate current for any appreciable period of time while adjustments are made to the loading. It is therefore necessary to make preliminary adjustments at a current in the order of 50 milliamps and then turn the carrier level control up to produce around 150 milliamps of current and QUICKLY make the final adjustment.

As a good rule of thumb we suggest never allowing the final to remain at 150 milliamps for more than five seconds at a time. With a little skill, and using the RF position on the meter, tuning can be carried out within this short period but if you find you have not completed the adjustment in five seconds, then switch off at the function switch and wait at least 10 seconds before switching on again and completing the adjustment.

For CW operation the final should be loaded to the same order of plate current and with the same reservations on tuning up as should be observed with DSB operation. ■

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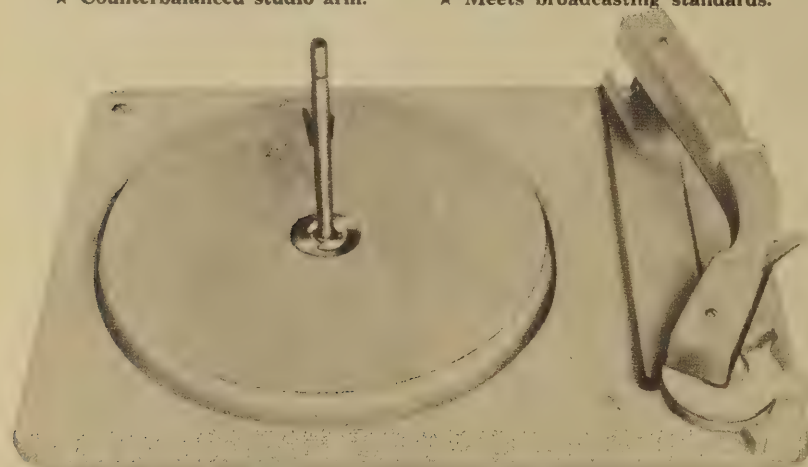


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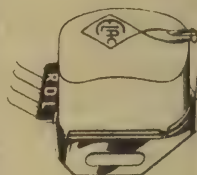
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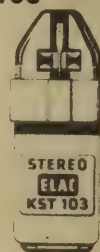
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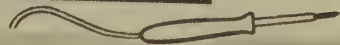
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The Serviceman



DIAGNOSIS VIA THE TELEPHONE

One of the problems which most servicemen encounter from time to time is that of trying to diagnose faults by some form of "remote control," as, for example, over the telephone. And, no matter how much one tries to discourage such calls, a certain number are inevitable.

One such situation is where customers simply need to be reassured. Particularly where a set has lost its picture, the owner will ring up, often late in the evening, give a hurried description of the symptoms, and then wait plaintively, "Do you think it's the picture tube?"

One can never be sure, of course, but a little questioning often reveals enough to enable a cautiously optimistic answer to be given. Thus reassured, the owner presumably retires with an easy mind, instead of fretting the precious hours away worrying about his bank balance.

Another is where people fear that obvious "faults" —they may be nothing more than locally generated interference — will damage the set if allowed to continue. Can they watch their favourite program tonight, or until the serviceman can have a look at the set?

Once again, one can often reassure a customer — and create some goodwill into the bargain.

Unfortunately, they are not all this easy. Quite apart from the fact that some customers have ulterior motives —endeavouring to elicit which valve needs to be replaced, so that they can buy it wholesale — the majority are pretty much a dead loss when it comes to describing symptoms. They are more likely to cloud the issue than clarify it. What's more, even if one can come up with the right answer, there is seldom much the owner can do about it.

For these reasons, therefore, satisfactory diagnosis and repair on this basis is very much the exception. Nevertheless, when one does tackle it, and it comes off, it gives the old ego a terrific boost. And, just between ourselves, mine can do with a bit of a boost now and again.

As you have no doubt guessed, this is all leading up to a story.

The person concerned is a friend and one-time customer who now lives in a distant suburb, and whom I see only occasionally. He has some knowledge of radio and TV, at least on a practical basis and has managed, with the aid of a service manual, to cope with all the faults which have occurred in his TV set so far. Perhaps he has been lucky, but I imagine that he is just as good as the average valve jockey, at least on his own set.

This, then, is the background to a telephone call I received from him early one evening a few weeks ago. And, while

it didn't add anything to Mrs Serviceman's housekeeping allowance, it did serve to renew an old friendship as well as boosting the aforesaid ego

It seemed that he had encountered a set of symptoms which were sufficiently puzzling to cause him to seek assistance, at least to confirm what he suspected was happening. In simple terms, the set had suffered an instantaneous and complete loss of picture —and raster—plus a noticeable drop in sound level.

It was this partial loss of sound which puzzled him. Had it been complete, along with the loss of picture, he would have assumed a loss of HT, possibly due to a faulty rectifier. As it was, he decided to try a new rectifier anyway, reasoning that there might have been a partial loss of HT sufficient to disable the picture circuits without completely upsetting the less critical sound circuit. It seemed like a fair bet and, as he put it, "the old rectifier had been in the set since it was new, and doesn't really owe me anything."

So the next day he bought a new 5AS4 and that evening replaced the old one with it. Then he switched on hopefully. Sure enough the picture came up as clear as ever, together with normal sound. So he settled back to enjoy an evening's viewing.

Alas for his hopes. The set ran for about five minutes, then—kerput! No picture, and noticeably weaker sound. He was right back where he started.

He removed the back of the set, probed around inside for a while looking for anything which would provide a clue and then, finding nothing, switched on again. Again everything worked perfectly for a few minutes and again the picture cut out and the sound dropped. He soon established that this was a definite pattern. While the set was cool it would play normally; when it warmed up, it failed.

This suggested to him that one of the valves heaters might be intermittent; the kind of fault where the heater is continuous when it is cold but goes open circuit when it gets hot. Working on this theory he carefully observed all the heaters as the set played, expecting to see one of these fail as the set failed.

This didn't happen, but what he did observe was that the plate of the 6CM5 line output valve was glowing red hot and that this condition started as soon as the set failed.

It was at this point that he decided to ring me. From the symptoms he suspected the 6CM5, but he didn't feel sure enough about this to go out and buy a new one on spec. As he explained it, he didn't mind buying a new valve if there was a fair chance that the fault was in that section, even if it subsequently transpired that some other component was the culprit. However, he didn't feel too happy about taking such a chance if it was more likely that the fault was somewhere else. What did I think?

I replied that the 6CM5 appeared to have all the symptoms of a line output valve that had lost its grid drive. As I explained to him, line output valves are class C amplifiers, exactly the same as used in transmitters. They derive their bias from the grid current which flows with each positive half cycle applied to the grid. Deprive them of this—that is the drive—and they can generate no bias. And a valve of this kind, with full plate and screen voltage applied, running with no bias, gets very hot very quickly.

On this reasoning it seemed to me much more likely that the fault was in the previous stage, the line oscillator. As I remembered the circuit, this used a 6SN7 as cathode-coupled multivibrator. Thus, while I agreed the heat sensitive nature of the fault suggested that it was most probably a valve, it seemed that the 6SN7 was a far better bet than the 6CM5.

Then, in a moment of bravado, I even went so far as to speculate what might be wrong with the 6SN7. It was not the first time I encountered heat sensitive faults in this valve, and it was almost invariably due to an open circuit cathode, often due to a faulty weld either at the base of the cathode, or where the cathode "pigtail" joins the lead-through wire to the pin.

At the same time I commented on my friend's previous suggestion that it might be an intermittent heater. To me, this seemed unlikely for two reasons. In the first place, the failure of the picture was instantaneous and complete, which would be unlikely if the cathode simply cooled down slowly. Secondly, valves exhibiting this fault usually cycle; that is, as soon as they cool down the heater circuit is restored and they commence to function again, repeating this cycle indefinitely.

And what about the drop in sound level? It wasn't quite so easy to be precise about this, but I suggested that it was probably due to a drop in HT caused by the heavy current drain when the 6CM5 lost its bias. Presumably this was sufficient to produce a noticeable drop in level, at least by direct comparison.

The answer to all this speculation came the following evening, when I received a jubilant phone call from my friend, announcing that everything had worked out as I had predicted. He had bought a new 6SN7, plugged it in, and obtained perfect performance. And not just for five minutes. I gathered that the set had been running for a couple of hours before he rang me.

But that was not all. At my suggestion he passed the faulty valve on to a mutual friend, who in turn passed it on to me. I was anxious to see how close I had come to the right diagnosis.

In the valve tester, both halves gave a "good" reading, initially, thus behav-

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ing as they had in the set. However, I left the valve in the tester for about 15 minutes, hoping that the heater alone would produce sufficient heat to create the fault. Sure enough, when I tried it a second time, one half had failed.

I could not determine, from the tester, which element was at fault, but a close examination of the valve through a magnifying glass confirmed my suspicions. Even after it had been taken from the tester and cooled somewhat, a break was clearly visible at the base of one cathode, where the "pigtail" came away to join the lead wire.

So there it was; a one hundred per cent accurate diagnosis by telephone. I wish I could do it every time, I'd sell the truck and spend my day at a desk answering the phone—for a fee!

My next story, while intriguing in itself, also served to remind me of what we sometimes call the "good old days" and of the truth of the adage, "There's nothing new under the sun." More specifically, it reminded me of the old autodyne receivers and the strife the handyman owner could create when he imagined that the set was not performing properly and that it was time to have the valves tested.

Having carefully—ever so carefully—removed them, he would wrap them in enough newspaper to paper a room, carry them gently to the nearest service shop, and have them tested. If, as so often happened, they all tested good, he would rewrap them and carry them home again with equal care, and replace them in the set. And nine times out of ten the set would now refuse to function at all!

Why? Well, if you don't already know I'm not going to spoil a good story by telling you—yet. However, I will say this. It wasn't because the wicked serviceman had deliberately "blown" the valves in order to make the set owner buy new ones; an accusation I heard voiced on more than one occasion.

The set which reminded me of this almost forgotten problem was a non-descript mantel set which, as I received it, appeared to present nothing more than a routine job. According to the owner it was completely dead, having stopped abruptly in the middle of a program.

So, in fact, it seemed to be, for it took me only a few minutes to track down an open circuit speaker transformer. Unfortunately, a new transformer didn't cure the trouble. It put the audio section back into operation, but there was only a faint whistle from the front-end, and no sign of any signals.

As a first step I reached for the signal generator lead and clipped it to the aerial terminal. Sweeping the generator over the broadcast band, with the attenuator flat out, produced not a sound. I switched it to 455KC to see if I could brute force something through at this frequency, as is usually possible. Once again there was nothing.

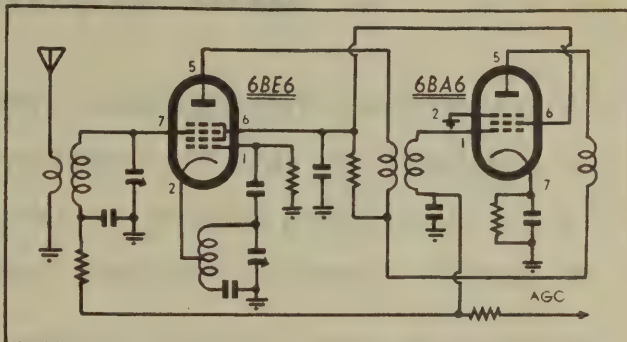
I turned the chassis over and clipped the generator lead on the plate pin of the converter socket. This time I made some progress. Generator signals appeared in the speaker, not exactly "loud and clear," but it was the best effort so far. It now seemed fairly obvious that the converter stage was completely dead, probably due to a defunct 6BE6.

So, I went a new 6BE6. Now, for the first time, I heard stations but it was immediately apparent that there was more trouble to be corrected. Overall

sensitivity was extremely poor, together with heterodyne whistles and some background hum when tuned to a station.

A faulty IF amplifier stage? Probably, though exactly what form the fault took was not apparent. It could be a faulty component, such as a screen bypass, or it could be a faulty valve. Mainly because it was easiest, I pulled the valve out of its socket, intending to replace it with another one. And, while I hadn't taken particular note of the valve type involved, I had automatically assumed that it would be a 6BA6. It was something of a shock, therefore, when I glanced at the markings on the envelope and realised that the second letter of the group, while somewhat mutilated, could never have been an "A."

The circuit of the receiver front-end, as it would normally be. Try to visualise what would happen when it was upset as described in the text.



More careful examination suggested very strongly that it had been an "E," but what was a 6BE6 doing in the IF amplifier socket? Unless . . . I reached for the "6BE6" which I had removed from the converter socket and took another look at it. Its markings had been completely obliterated but a closer look at the structure confirmed my suspicion. It was clearly a 6BA6. I replaced it in the IF amplifier socket, pushed the original 6BE6 into the converter socket, and away went the set like a new one.

It was all clear now, and I couldn't help chuckling when I realised how this classic mistake had been resurrected after all these years. In the old days it used to be the 57—the "autodyne" oscillator mixer—and the 58—the IF amplifier—which were transposed.

These two valves were the same size, used the same base—a popular means of identification to the uninitiated—and generally looked identical. But they weren't interchangeable. While the IF system might work in a fashion with a 57 in the socket, the autodyne circuit certainly wouldn't work with a 58.

Often, in damp weather, they wouldn't even work with a 57.

My present customer, I imagine, had been similarly trapped. When the set failed he had removed the valves to have them tested and, when this revealed nothing helpful, he had simply replaced them where he thought they should go. Unfortunately, he had been unable to distinguish between the two similar looking valves, one with a mutilated marking and one with no marking.

An understandable mistake, I must admit, but it would have saved me quite a lot of time had the owner seen fit to confide in me. As it was, I'm afraid he was billed for his reticence.

However, looking back on the incident, it is interesting to speculate on the behaviour of the two valves in their wrong sockets. As the set was when I received it, the 6BA6 in the converter socket had no chance of oscillating and little chance of doing anything else.

While its plate and screen were logically connected, its signal grid had been sidetracked into the local oscillator coil, while the aerial tuned circuit finished up in series with the cathode and the AGC line. Perhaps it would have passed some signal if one had fed it into the right place, but it would have been in spite of rather than because of the configuration.

On the other hand, the 6BE6 in the IF amplifier socket was capable of functioning in some measure. The plate connected correctly to the 2nd IF primary, and the screen grid to the appropriate dropping resistor. The control grid missed out, being connected effectively to chassis via the RC network intended for the cathode. Likewise, the cathode was con-

nected direct to chassis without the benefit of a bias network. However, the oscillator grid was connected to the 1st IF secondary, and presumably functioned as a signal grid. Not ideal conditions, but they did work.

This was demonstrated when I fitted a genuine 6BE6 in the converter socket, and generated some signals for the IF to handle. It handled them, but only just.

To change the subject, here are a few short stories on the lighter side. Invariably, when servicemen get together, they talk shop. Sometimes they discuss the more off-beat types of faults they have encountered since they last met but, more often, it is the off-beat customers, and the strange faults they sometimes create, which take pride of place.

At one such recent gathering the conversation turned to the condition of sets—inside the cabinet—when the serviceman opened them. Most agreed that they were usually pretty dusty, particularly around the EHT cage where the high voltages and electrostatic charges seem to attract any particles of dust or fluff within a radius of several yards. But everyone also agreed that there was little that could be done about it, since it would be fatal to let the average housewife loose inside the cabinet with a rag or feather duster.

This prompted one of the group to boast that he could pick the type of street in which a set "lived," simply by examining it in the workshop. For example, he explained, an unmade road will produce a much heavier layer of dust, often of a distinctive colour, than will result from a sealed road. Also, he went on, one could get some idea of the kind of furnishings, by noting the amount of "fluff" which was present.

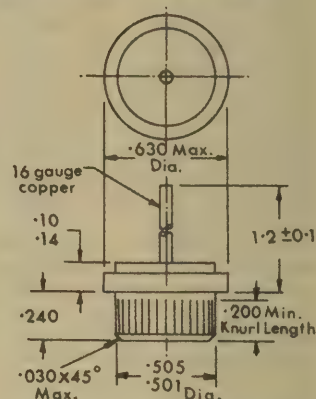
Nobody seemed to doubt this, but several raised the question as to the practical value of such observations. Someone else suggested that it might be useful to assess the ability of the customer to pay his bill. If, for example, he lived in a paved street and had



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Average half wave recti- @ 100°C case fied forward current. @ 150°C case	30 25	30 25	30 25	25 18	25 18	25 18	Amps
Recurrent peak forward current (50 cps and 25°C case)	100	100	100	75	75	75	Amps
Peak one cycle surge current (50 cps and 150°C case temp.)	400	400	400	300	300	300	Amps
Forward voltage drop @ 25 Amp. D.C., Forward current	1.2	1.2	1.2	1.2	1.2	1.2	Volts
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carpet on the floor, he should be a better pay than someone living at the end of a bush track in a house with bare floors.

But this suggestion was not well received. Apart from the difficulty of trying to judge peoples' characters by their financial status, one member made the point that a customer who had just invested in wall-to-wall carpet in every room was probably so broke that he couldn't afford to buy a replacement fuse.

This ended this line of discussion, but mention of new carpet reminded another member of a recent experience where he serviced a TV set in a house which, he later learned, had been re-carpeted about six months previously. The whole of the chassis, and the EHT cage in particular, was covered in a thick layer of fluff. On parts of the EHT cage it was—literally—over a quarter of an inch thick.

Naturally, this caused a good deal of embarrassment to the housewife when the chassis was extracted, and she explained about the new carpet, adding that it had created a lot of fluff throughout the house when it was first laid. She also explained that the women next door had told her that it was unwise to use a vacuum cleaner on a new carpet, so she had simply swept it for the last six months. Small wonder the poor TV set could hardly breathe. My colleague, who has an extensive appliance business, quickly offered some free advice aimed at disillusioning her about the supposed perils of vacuum cleaners on new carpets.

From here, somehow or other, the conversation turned to the strange explanations people give to various malfunctions. I liked the one where a customer had rung this particular member of the group, explained that the set had lost its picture, and then suggested, quite seriously, that he ".... come down and put a new globe behind the screen."

This led to a discussion of customer ignorance in general and produced the next two stories. One concerned a family who purchased a TV set shortly after the service was introduced and who were apparently unfortunate enough to be supplied with one which had poor horizontal hold; such that it was very prone to lose hold whenever the channel was changed.

This defect was subsequently corrected, but not until the service organisation had made several visits to the home, and taken the set back to the factory on two occasions. And while this was going on, the head of the house became obsessed with the idea that the fault was caused by the act of changing channels. Presumably, he imagined that changing channels exerted wear and tear on that part of the set which governed the horizontal hold.

As a result, he decided that there was to be no more channel changing. If the set was on channel 2 when it came back from the factory, or after the serviceman had been, then channel 2 was the channel they would watch. What was more, he issued a strict edict to his wife and two children to this effect, and was sufficient of a martinet to enforce it for the next couple of years, at least in theory.

I say, "in theory" because it was

inevitable that there was considerable secret rebellion and clandestine channel changing. Whenever the "old man" was out of the house someone would take a risk and change to another channel, hoping that the program would finish before he returned, and taking care to reset the selector to the "official" channel to avoid detection.

And, equally inevitable, those who took the risk were sometimes caught. Then there would be ructions galore, and the "old man" would lay down the law about damaging the set; about there being no money to fix it when it was worn out; about his right to be obeyed in his own household; and so on.

Eventually, I gathered, the old skinflint "woke up to himself," mainly as a result of the family's simmering discontent turning to open revolt, but also due to an increased awareness of how a TV set should behave and that none of his cronies seemed to have this kind of trouble. So he discreetly turned a blind eye to the family's increasing defiance, until the whole thing died a natural death.

But it must have been torrid while it lasted, as well as being almost incredible in this day and age. Nevertheless I have no reason to doubt the story.

The final story is about a similar problem, but set against a background just about as different as it could be. The customer in this case was a little old lady who, in defiance of the hustle and bustle of today, managed to retain much of the charm and graciousness of a bygone age.

"And," the storyteller added, "I could do with a few more customers with her manners and charm. She made me realise just how boorish some people

correctly, but finally came to the conclusion that this was the owner's way of discreetly satisfying herself that they were functioning properly.

However, the next time he had occasion to service the set he was faced with the same polite request. Only then did the full implication of it dawn on him. Surely the dear old soul had not been watching the set for all these months with the controls set as he had left them on his last visit.

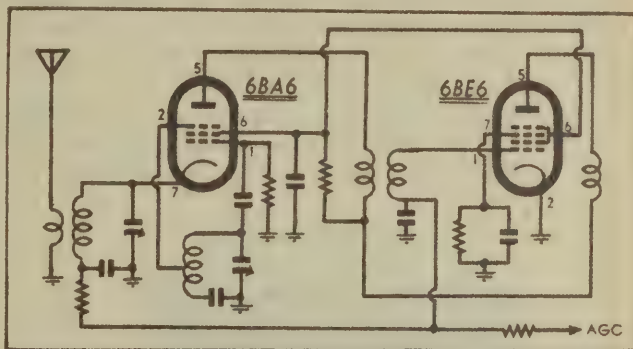
But discreet questioning revealed that indeed she had. In vain he tried to explain that the controls were provided for the user's benefit; that it was impossible to provide one setting which would cope with all channels, programs, viewing conditions, etc.; that adjustment of the controls could do no harm and would improve her viewing pleasure immeasurably.

It was no good. The dear old lady was adamant. She didn't understand anything about electricity—an all-embracing statement which, in her mind at least, explained everything — and so she would be quite happy if Mr Smith would simply set the controls as he had done before. She added that his previous adjustments of these had been very satisfactory, and if he would just leave them the same this time she was sure she would be happy with them.

"I did my best, of course," he explained, "but I hate to think what the dear old soul puts up with during some of these commercials with their brute force sound, or some of the old movies with their soot and whitewash contrast, or when trying to listen to some of the nervous 'interviewees' who mumble in their beards about 20dB down."

And that, he went on to explain, was several calls ago. He now takes this

In case you couldn't visualise the transpositions described in the text on the previous page, here is the circuit as it was when I received it.



can be when they imagine they have a grievance."

Unfortunately, the gracious age had done little to prepare her for life with television and, while she was sufficiently alert to derive considerable enjoyment from this twentieth-century marvel, the technicalities of the system—in the form of the numerous knobs of the front panel — were more than she could cope with.

The first hint of this problem came with the first service call. Having located and fixed the fault, which was only minor, our serviceman was about to leave when the dear old lady raised one more point. Would Mr Smith be kind enough to set the volume, contrast, and brightness controls before he left?

Mr Smith was quite willing to oblige, of course, but he was rather puzzled by the request. He had already satisfied himself that all these were working

job as a matter of course and has given up any idea of trying to educate the old lady.

"Strangely enough," he added as an afterthought, "she seems to have no difficulty or qualms about changing channels. But, beyond that, she takes what comes."

The story raised the normal quota of chuckles, but I couldn't help feeling it was more pathetic than funny. It was easy enough to laugh from where we stood, but I wonder how many of us will be able to cope with all the scientific and technological advances which will undoubtedly have come about by the time we reach the same age. Even with a technical background we may well find that the commonplace devices of that era — perhaps not even thought of today — will be sufficiently bewildering to cause us to retire into our shells and leave the "obvious" adjustments to someone else.

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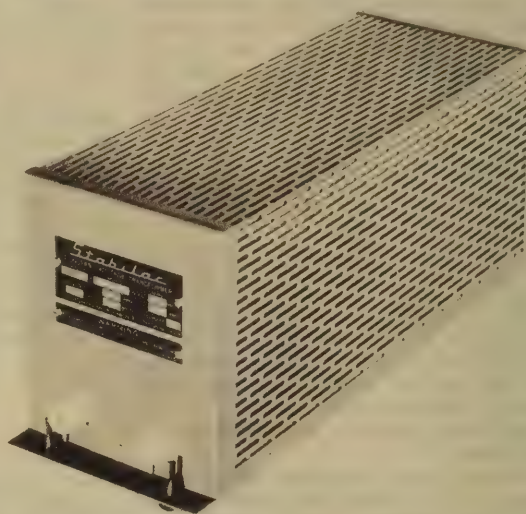
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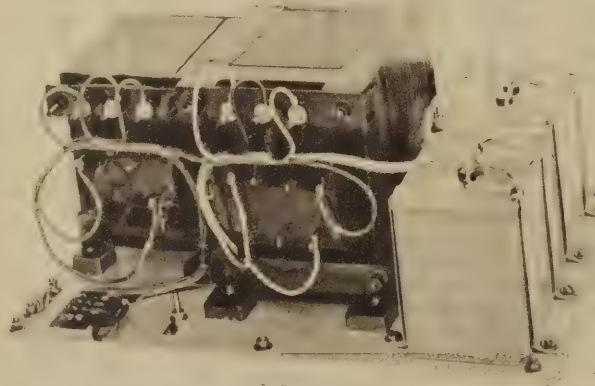
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Forum

GET WELL—ELECTRICALLY

Do you suffer from atomic headache? Is atomic fallout giving you a sore throat? Or sinus infection? Perhaps your bloodstream is worrying you, or your intestinal tract or your digestive area. Why not de-radiate yourself with a simple gadget that will cost less to build than a crystal set?

By W. N. Williams

IN case you think that I have taken leave of my senses, I must hasten to assure you that the sudden preoccupation with matters medical is prompted by a letter which came to hand recently, intended for the "Reader Built It" page. Subject of the letter was a gadget made up from three resistors, a battery, a small coil and a few other oddments, housed in a plastic soapbox. The "circuit" is as shown below.

If the circuit intrigued me, it had nothing on the rest of the letter describing what the gadget could do. I quote:

"This gadget has the positive vibrations or wavelengths which are the direct opposite to leukaemia; some not very strong but the main ones from 230 to 242 are very strong . . . the uranium group atomic weight as they call it.

"For those who can use a pendulum or divining rod . . . you will perhaps find the vibrations of this are GOOD on nerves, bloodstream, intestinal tract and digestive area and counteract rheumatic tendency and have some of the LIFE FORCE.

"In case you find the same numbers as I do here, they are 1.4, 8, 31, 65, 99, 132, 230-242, 361, 500.

"Which means in effect that this would cure an atomic headache, sore throat or sinus infection caused by atomic fallout, as well as lessening the chance of cancer and leukaemia.

"Do not have it on for more than half-hour at a time. If left on all night I wake up with a headache which soon wears off.

"Use this on the table 10 minutes before food is eaten to de-radiate food. Put on bed quarter-hour before and a while after getting into bed. It can be put in the wardrobe a while to de-radiate clothing.

"Try it on plants.

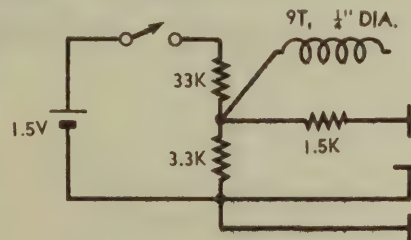
"Good health. Oh, milk is the greatest

accumulator of atomic fallout; de-radiate milk for five minutes always."

I must confess to doing a complete double-take on reading the foregoing, as also did some of my technically equipped confreres and a doctor friend who happened to come in to the office at the appropriate time.

Judge for yourself but, in the light of anything we'd ever learned or experienced or read, the whole thing sounded like complete and utter hocus-pocus.

Electrically, the circuit does nothing but discharge a torch cell through a couple of resistors. It has no apparent ability to generate "rays" of any description nor to exhibit absorption other than what any inductor will exhibit at the frequency to which it is naturally resonant.



With a suitable grid-dip meter or ready-reckoner tables, amateur station operators are readily able to deduce the resonance figure for such coils. In fact, they use large numbers of them for resonant circuits and filters.

But what all this has to do with leukaemia, atomic fallout, digestive tracts, life force and vibrations is beyond me—and I venture to say beyond anyone else with an ounce of technical background.

To be sure, plenty of scientifically minded people are concerned about

atomic fallout and its possible ramifications in regard to health in general, and leukaemia in particular, but they have also studied it in great detail and developed elaborate equipment to help them to measure and control it.

What fools they would be if they needed only a few cents' worth of electrical miscellanea to "de-radiate" things and people!

Reading the letter, it was hard to escape the conclusion that the writer had simply pulled the old, old trick of stringing together big words, with enough mutual association, to make their combination sound plausible to the technically naive. The motive for so doing might vary all the way from grandeur to greed.

On the other hand, of course, the whole thing could have been a leg-pull, more appropriate to April 1.

So I replied in strict business terms requesting a technical explanation for the remarkable properties exhibited by such a simple device.

The letter I received in reply ruled out the "leg-pull" theory and left me in no doubt that the writer meant what he had written — and more. I quote: "Re your inquiry as to the reason why the unit produces radiant energy that counters atomic fallout:

"THERE IS NONE that I know of. Yet it is a fact that those who have Extra Sensory Perception (E.S.P.) can detect a radiation from this gadget. These vibrations in the ether DO have an effect on people who are suffering from the effects of fallout.

"Anyone who can use a pendulum or rod or other divining instrument can demonstrate that these vibrations are present when it is turned on.

"It is the same idea as de-radiating houses to eliminate earth rays or other harmful rays or vibrations or whatever the radiant energy is."

So the recitation continues, becoming more improbable as it does so:

"I would say that I have used 250 or 300 different arrangements to treat houses. Some authorities maintain that coils of wire will de-radiate buildings. I have found to my cost that these can leave some of the multitude of BAD rays still active and great care is needed in the type of gadget, their placement, height above or under ground and their orientation. I've used stones, wires, coils, household articles, horse-shoes, chemicals in bottles, or just changed the position of some article that was collecting and distributing earth rays."

The writer concludes with stories about fruit trees that died or didn't die, because of these effects and their eliminations — and fowls, for good measure.

Should I be in doubt, he offers any number of testimonial letters.

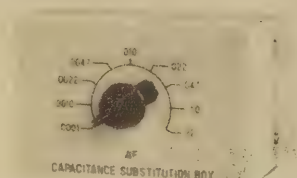
I'm afraid that I'm not very open to conviction by testimonial letters, particu-



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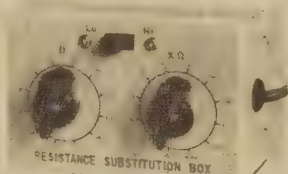
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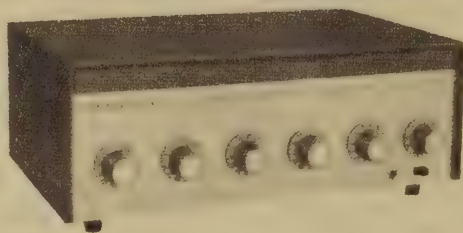
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Less than 3% (max. output).
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Input

Frequency response
Distortion
Input sensitivity

Hum and noise
Output impedance
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35 watts.
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MIC—2 crystal or dynamic.
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tape recorder, tuner.
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3% at 30-watt output.
MIC input 5 MV.
AUX 300 M.V.
54 DB.
8, 16, 250 ohms and 70V line.
1—12AX7. 1—6AV6.
1—6AQ8. 4—6BQ5.
230 volts 50-60 cycles.

£45/19/0

larly where the testimony is in support of something which can find no technical, scientific or other correspondence with the mainstream of human knowledge.

There is not the slightest doubt that people have been cured of certain "ills" by a changed mental attitude, whether that change has been brought about by orderly psychological treatment, religious influence or by auto-suggestion stemming from random hocus-pocus.

An interested party may collect testimonial letters from the last named group but their real significance is to underline the importance of mental attitude — not the imagined powers of some particular individual or the pseudo-scientific efficacy of his remedies and gadgets.

But what do I say to all this?

Strange letters are not unique in our mailbag but they never get into print. If a person suffers from delusions of one kind or another, it is unfortunate for that person and for their immediate contacts; it is not a matter for public spectacle.

But the overtones of this letter invite the inference that our correspondent's activities are on a wider scale. He says, *inter alia*:

"I have de-radiated over 1,000 houses and many people can bear witness that their health has improved or that they are protected by these devices. . . ."

"Every case of cancer I have investigated has had these lethal earth rays affecting the patient at night (when the body is negative and receptive). Rheumatism, heart troubles are accentuated by sleeping over bad earth rays. . . ."

This I do not like. It smacks of quackery of the most mischievous kind — this time with a pseudo-electronic slant.

These paragraphs will have served their purpose if they contribute to public rejection of this kind of activity. There is even a faint hope that it may stir the person concerned to re-think his own position.

THOSE CHIPMUNKS

To change the subject completely, I have been holding a couple of letters from readers on the subject of "Alvin Generators" referred to in the August issue, last. Under discussion were the devices, or the techniques, used by Alvin and the Chipmunks to produce their crazy but entertaining speech and songs.

In the particular issue, we suggested that anyone with a tape recorder could produce the effect by mouthing words very slowly but at normal pitch, recording meanwhile at half speed. When replayed at normal speed, the rate of articulation will have come up (we hope) to something like normal, but the pitch will have jumped an exact octave.

Commenting on this, a reader from Toorak, Victoria, admits that this kind of approach is possible but cumbersome. In the letter reproduced above, he draws attention to a device called a "Springer Machine" and to an article describing it. We don't have the article to hand but the reference is there for those who may wish to follow it up.

Another letter on the same subject, from J.R.T. (Earlwood, N.S.W.) is worthy of comment. J.R.T. introduces himself as a trainee technician, with an apparent interest in electronic organs,

"ALVIN GENERATORS"

Dear Sir,

On reading your "Answers to Correspondents" in the August issue of "Electronics" in reference to your answer to J.S. of Vaucluse on the "Alvin Generator"; while your explanation will produce the effect, it is somewhat cumbersome and unreliable to use in this way.

The Chipmunk recordings are executed with a device called the "Springer Machine" which consists essentially of a series of multiple recording-playback heads arranged radially around a wheel which is in contact with the tape. By control of the speed and direction of rotation of the head assembly, the pitch can be raised or lowered without altering the timing; alternatively the timing can be speeded or slowed and the pitch kept constant.

Further information on this device can be obtained from a publication from the National Research Council of Canada, Technical Translation No. T.T. 859.

Yours sincerely, V.T.S.

electronic guitars and audio affairs and effects generally.

Prompted by a suggestion from a senior staff member, he is planning a project which, he hopes, will allow him to reproduce Chipmunk effects at will, plus frequency doubling effects applicable to musical instruments.

On the surface, the scheme sounds delightfully simple.

1. Use the original audio to modulate an ordinary RF carrier.

2. Use frequency doubling to double the frequency of this carrier, along with the frequency of all sidebands associated with it. The sidebands will now be separated from their parent carrier by twice the original audio frequency.

3. Demodulate to recover the audio component, now multiplied by two, and amplify. The job is done.

Our correspondent says that he has a 1270KC crystal which will suit his purpose nicely.

If this is modulated by, say a 1KC tone, sidebands will be produced at 1269 and 1271KC. When the combination is frequency multiplied, the new figures will be 2540KC for the carrier and 2538 and 2542KC for the sidebands.

The resultant will surely be 2KC out instead of the original 1KC in.

This is one of those statements which to me, as an old hand, rings a loud warning bell.

Something doesn't check.

If it was as easy as all that—and the idea is not a remote one—electronic organ manufacturers would have been on to it long ago to get themselves, very cheaply, some extra octaves.

And again, why don't the harmonics from broadcast stations, heard on the short-wave band, sound high pitched when resolved in a receiver?

Come to think of it, how do you frequency multiply a modulated signal, anyway?

As set out by our correspondent everything sounds so easy Just multiply all the frequencies by 2.

But think now of a practical frequency doubler stage, heavily driven and biased, operating into an anode circuit tuned to twice the frequency of its input signal. Driven, as normal, by an unmodulated RF carrier, it acts as a kind of triggered or externally driven oscillator, to generate what is virtually a new signal altogether, frequency locked to the original drive.

If the drive were modulated, much of the modulation would disappear forthwith, because of the saturated grid drive condition.

Inevitably, some of the modulation would get through but it is reasonable to assume that the periodicity of the audio envelope present in the drive would appear substantially unaltered in the output waveform. In other words, the peaks and troughs of drive would produce corresponding undulations in the output of the stage.

In short, something would seem to have gone wrong with the simple idea of everything being multiplied by 2. One might expect that a good deal more would happen at the same time.

Since the modulated grid drive would vary the efficiency of the stage as a doubler, this would produce a non-linear modulation transfer to add to that of the saturation on peaks already mentioned.

And speaking of non-linearity, what about the sum and difference products which would appear and get mixed up with the original modulation?

In fact, the subject turns out to be a real "beaut" for purposes of argument and, before we had gone very far into it, in our own laboratory, we had dragged in harmonics of local broadcast stations, what kind of distortion affected them, whether it was related to the kind of modulation and final amplifier, harmonics from SSB transmitters and so on.

I pass it on with my good wishes for your argument and attention.

But, in the meantime, while the arguments are in progress, I can't think that the chances of success are high with an "Alvin Generator" along these lines.

On the other hand, our correspondent may have ideas about some other kind of frequency multiplier,

(Continued on Page 158)

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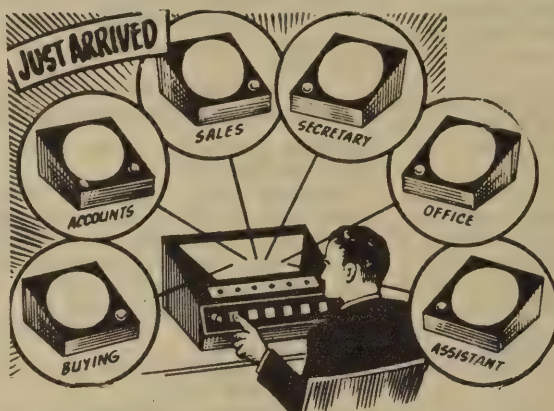


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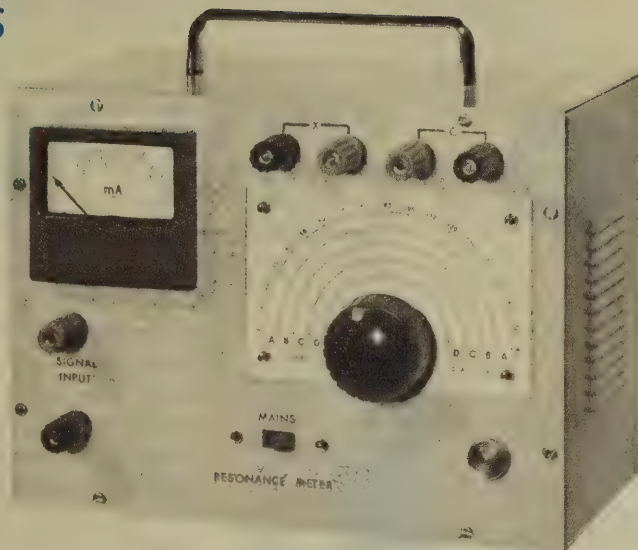
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TEST TUNED CIRCUITS,
COILS, CRYSTALS WITH THIS

RESONANCE METER

The instrument described in this article can be used in conjunction with a suitable RF or audio signal generator, or oscillator, to measure the resonant frequency of RF or audio tuned circuits. It can also be used for measuring the inductance of unknown coils, circuit "Q" and selectivity. Simple and inexpensive to build, it should make a worthwhile addition to the service or amateur workshop.



TWO rather different instruments are commonly used to measure the resonant frequency of tuned circuits: the Q-Meter and the Grid-Dip Oscillator. However, the Q-Meter tends to be a rather costly instrument, and is used mainly in laboratories; it is the Grid-Dip Oscillator which is most often used for service and amateur work.

Because the Grid-Dip Oscillator relies upon magnetic coupling with the circuit under test, it has a number of drawbacks. For example, testing tuned circuits in which the coil is normally shielded is a problem, because the shield makes magnetic coupling impossible. Removing the coil shield permits coupling to take place, but makes it hard to interpret the results because the resonant frequency of the circuit will alter when the shield is removed.

The very magnetic coupling upon which the operation of the Grid-Dip

Meter depends proves to be its downfall, where accurate measurements of resonant frequency or coil "Q" must be made. This is because the exact frequency of the dip oscillator depends upon the test circuit and the amount of coupling, and varies slightly in use.

It is possible to make measurements of tuned circuits using shielded coils and to make fairly accurate measurements

of resonant frequency and "Q" using the instrument to be described, which we have given the name "Resonance Meter." It is a unit which mates with a signal generator or test oscillator, of either the audio or RF variety as appropriate, to form what is virtually a "poor-man's Q-Meter."

Basically, the unit consists of an un-

tuned amplifier and a detector-meter circuit. There is also a variable capacitor which may be used to connect a known amount of capacitance to the circuit under test. The diagram in figure 1 should help in understanding how the unit operates.

The input of the untuned amplifier is connected to the signal generator or oscillator with which the instrument is

by Keith Woodward and Jamieson Rowe

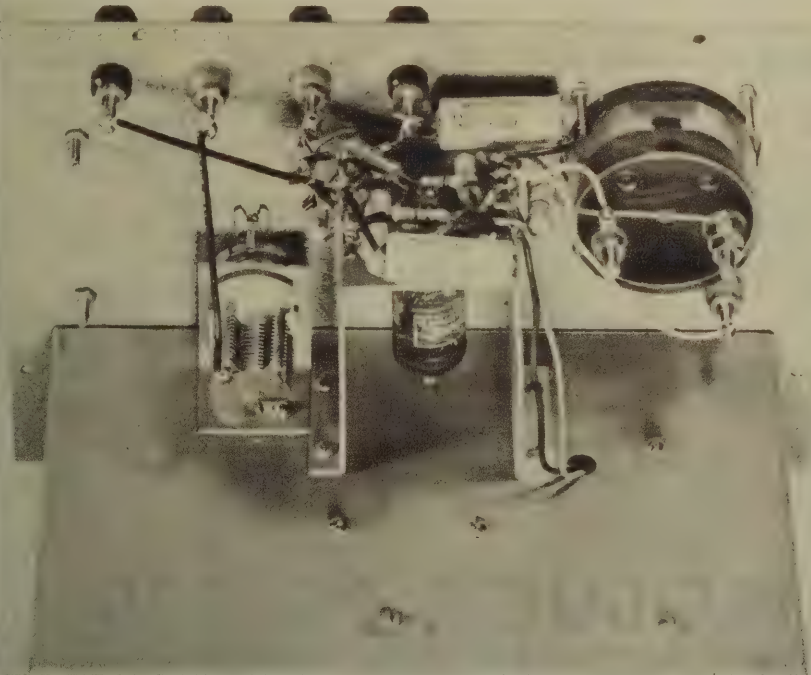
used. Its function is both to boost the oscillator output to a convenient level, and to provide a fairly high impedance source of signal to drive the circuit under test. The output of the amplifier is coupled via a capacitor to the test terminals.

The input of the detector and metering circuit also connects to the test terminals. Thus if no external circuit is connected to the terminals the detector receives the full output of the amplifier, and the meter will read. The reading obtained will depend upon the setting of the oscillator output attenuator, and will normally be set to full-scale using the attenuator control on the oscillator.

If an external circuit is connected across the test terminals, its impedance will tend to reduce the voltage fed to the detector and meter, because it will tend to form a voltage divider with the output impedance of the untuned amplifier. The meter reading will thus be reduced, by an extent which indicates the impedance of the external circuit—a high impedance will cause only a slight drop, while a low impedance will cause a considerable drop.

Most of the tuned circuits used in electronics are parallel resonant, and the impedance of parallel tuned circuits rises to a peak either at or extremely close to their resonant frequency. At all other frequencies they present a low impedance. It is this behaviour upon which the resonance meter relies.

If such a circuit is connected across the test terminals of the instrument when the input generator or oscillator is tuned to some frequency other than its resonant frequency, it will shunt the signal fed to the detector quite markedly



A view of the rear of the front panel, showing the general layout of signal circuitry. The valve is mounted upside down to keep wiring capacitance to a minimum.

RCF

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Sound distribution	120 deg
Air column length	350 mms
Power rating	6 watts
Watts peak	15 watts
Impedance	16 ohms
Frequency response	350 ÷ 10000
Maximum diameter	210 mms.
Maximum length	210 mms.
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H. 300

Low frequency cut-off	220 Hz	Watts peak	35 watts
Sound distribution	90 deg.	Voice coil impedance	16 ohms
Air column length	550 mms.	Frequency response	120-7,000 Hz
Maximum diameter	315 mms.	Maximum diameter	82 mms.
Maximum length	365 mms.	Maximum height	68 mms.
Weight	1,500 kgs.	Weight	1020 grs.
Power rating	18 watts	Complete with accessories for application for line transformer.	

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H. 450/5

Low frequency cut-off	150 Hz	Power rating	25 watts
Sound distribution	85 deg.	Watts peak	45 watts
Air Column length	915 mms.	Voice coil impedance	16 ohms
Maximum diameter	445 mms.	Built-in line matching transformer: 16—165—250—500—1000 2000—3000 ohms	
Maximum length	540 mms.	Frequency response	80-12,000 Hz
Weight	4 kgs.	Watertight construction	
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		Maximum diameter	110 mms.
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But if the oscillator is tuned to the resonant frequency of the test circuit, its impedance will be high and the meter reading will give a higher reading. As the oscillator frequency is tuned to the resonant frequency of the circuit a peak in the meter reading will indicate that resonance has occurred, and the frequency may be read off from the oscillator dial.

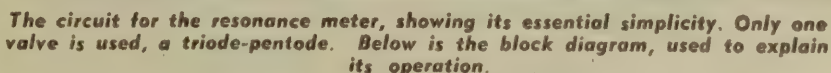
The inbuilt variable capacitor allows the user to measure the inductance of an unknown coil, as it allows the coil to be resonated at a known frequency with a known capacitance. The capacitor may also be used to determine the best L to C ratio for a tuned circuit for a given frequency and to measure the Q of a coil. The Q can also be measured by noting the oscillator frequency deviation either side of resonance required to reduce the meter reading to .707 of its peak value.

REPRESENTS
OF

It is also possible to make measurements of the resonant frequency and activity of quartz crystals, both at the fundamental parallel resonant frequency and at the third overtone. The

As may be seen from the circuit diagram only one valve is used, a 6U8 triode-pentode. The pentode section functions as the untuned amplifier and the triode as a high impedance cathode follower input for the detector circuit. The detector is a voltage-doubler type and uses two OA91 germanium diodes. It feeds the 1mA meter movement directly.

The power supply for the circuit is a light-duty voltage-doubler type using two OA210 silicon diodes or similar. The transformer used is a small wrap-over-bracket type used in a number of



projects in the past. A slider type mains switch is used, and there is a pilot lamp using an NE-2 neon bulb operated from the HT line via an 82K 1W resistor.

The main requirement when building the resonance meter is to keep stray capacitance to a minimum in the wiring associated with the test terminals and the variable capacitor. We therefore suggest that readers use the mechanical layout shown in the photographs. A metalwork blueprint will be made available, and constructors should either use this as a guide or purchase metalwork made from it, if they wish to be sure of correct operation.

To keep lead lengths to a minimum

we have mounted the 6U8 valve upside down, supported by a "U" bracket above the chassis. This keeps the wiring between the valve electrodes and the test terminals as short as possible, and thereby keeps lead inductance and stray capacitance to a minimum.

Owing to the necessity of using a standard commercial dial for the variable capacitor this component must be mounted down near the chassis, and the lead connection from its stator to the active "C" front-panel terminal is some 24in long. However, the additional capacitance involved is quite small as the wire is clear of the panel.

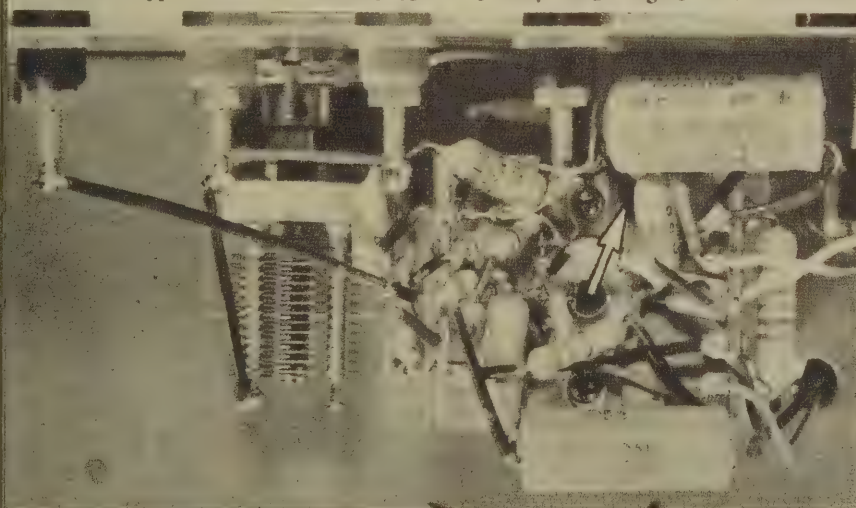
The variable capacitor used was a ceramic-insulated Japanese "Elepa" unit of nominal 100pF maximum capacitance. Constructors lacking any means of calibrating a variable capacitor would be advised to use this brand and type of capacitor, as a calibrated scale to suit this unit will be made available via the information service.

Note that the active "C" terminal will have a certain capacitance to earth, and this capacitance will add to that of the variable capacitor. Thus the total effective capacitance at the terminal with the variable capacitor at minimum is approximately 10pF, and at minimum 120pF. The prepared scale takes this additional capacitance into account, and is calibrated directly in effective terminal capacitance.

The active test or "X" terminal of the instrument will similarly possess a certain capacitance to chassis, and this will be connected across all circuits under test. In many cases this capacitance, which is quite small, should cause no problem; it may even simulate fairly accurately the circuit into which the tuned circuit being tested will ultimately be connected.

However, the presence of the capacitance should be remembered, as it will have to be taken into account when accurate inductance or Q measurements are being made. The total effective capacitance at this terminal in the prototype was 15pF; that of readers' units should be fairly close to this figure if the same terminals and layout are used.

The terminals used in the prototype were of the plastic screw-and-banana-



A close-up top-view of the valve socket wiring, which should aid constructors in duplicating it. The arrow indicates socket orientation.

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socket variety, having a small indexing spigot to prevent rotation when the clamping nut is tightened. As the front panel used was thin it was found necessary to use additional packing washers at the rear. These were made from 16g. aluminium. Constructors should duplicate this arrangement if they have no means of measuring the effective terminal capacitance, as other mounting methods may give a somewhat different capacitance.

The power supply circuitry is mounted beneath the chassis, as shown in the photographs. The wiring here is quite uncritical, and providing all components are well supported using tagstrips considerable latitude is possible. In any case, it should not be difficult to duplicate the original wiring from the photograph.

The neon pilot lamp used in the prototype was the type which comes complete in a small plastic bezel. Note that since it is connected to the HT line of the unit it will not extinguish immediately when the power is turned off: the HT voltage takes a few seconds to decay owing to the charge on the final 24uF filter electrolytic.

The power cord is clamped securely to the rear of the chassis so that the connections are less liable to be strained or broken by an accidental tug. Also all spare connections to the power transformer are terminated on unused lugs of the tagstrips.

The methods of using the instrument should be fairly obvious from the discussion of its operation. For example, to find the resonant frequency of an LC combination simply connect it across the test terminals and tune the RF or audio oscillator until the meter indicates a peak.

To find the inductance of an unknown coil, resonate it with the inbuilt variable capacitor at a suitable frequency f and calculate the inductance L from

$$L = \frac{1}{4\pi^2 f^2 C}$$

To pre-align a single-tuned IF transformer, simply connect it to the test terminals and set the oscillator or generator to the correct frequency. Then adjust the slug of the transformer for a peak.

The alignment of a double-tuned transformer is slightly more complicated. First peak one of the windings as above, then connect a suitable capacitor across its terminals to detune it well away from the correct frequency. This allows the second winding to be peaked up without interaction from the winding already aligned.

Remember to remove the additional capacitor when the pre-alignment is completed. If this is done before the second winding is removed from the test terminals, one can observe the way in which the peak of the winding is changed by the presence of the second winding tuned to the same frequency—tuning the oscillator through the peak region usually shows a "double-hump" effect.

If the oscillator or generator used with the resonance meter has reliable and fairly accurate frequency calibration, the meter can be used to measure or compare tuned circuit selectivities. The selectivity of a circuit is normally regarded as the bandwidth between its 6dB down points.

The tuned circuit is connected to the test terminals and the oscillator or generator tuned to the frequency of reson-

ance. The output attenuator of the oscillator is then adjusted so that the meter in the tester is at full-scale deflection. Then the oscillator is detuned to either side of the resonance peak until the meter reading has fallen to half-scale—a drop of 6dB. The difference in frequency between the two oscillator settings for the half-scale readings gives the bandwidth.

In a very similar fashion the Q of tuned circuits can be measured, although here if the measurements are to mean very much it is even more important that the generator or oscillator have reliable and accurate frequency calibration.

There are two possible ways of measuring Q using the meter. One, the so-called "incremental frequency" method, is as follows. As with the selectivity test the oscillator is first tuned to the resonance frequency of the tuned circuit, and the attenuator is adjusted for full-scale deflection on the meter.

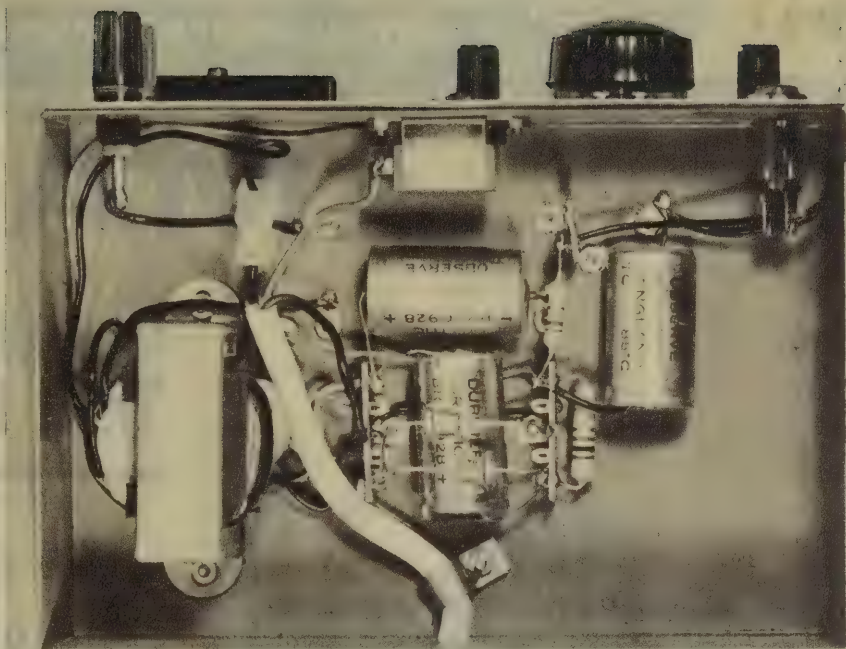
The oscillator is then detuned in either direction, but not until the reading has dropped to half-scale. This time the detuning points of interest are those where the reading has fallen to .707 of the peak value. If the two frequencies for .707 readings are symbolised by F_1 and F_2 , and the resonance frequency (full-scale reading) by F_0 , then the Q is given by

$$Q = \frac{F_0}{F_1 - F_2}$$

For example, if an LC circuit is resonant at 500KC and the two frequencies which give .707 of the peak reading are 525KC and 475KC, the circuit has a Q of $500/(525 - 475) = 500/50$, or 10. Note that even for this relatively low Q the oscillator frequency must be known within about 5KC in 500KC if the reading is to be of much value.

The alternative way of measuring Q depends not upon the calibration of the oscillator but upon that of the variable capacitor in the tester. Although the latter will be less accurate unless the builder has some means for individual accurate calibration, we give details of the method for those who may be interested. It is often called the "incremental capacitance" method.

Once again the oscillator is adjusted initially for full-scale deflection at the resonant frequency, but this time with



An underchassis view of the unit, showing the power supply circuitry. Few parts are involved, and it should be easy to duplicate. In any case the wiring of this section is not critical.

the variable capacitor set to approximately half-value and connected into circuit. Detuning is then carried out, but not by adjusting the frequency of the oscillator; rather, by adjusting the capacitor in the tester to detune the tuned circuit itself. It is adjusted both up and down to find the two settings which produce a drop to .707 full-scale on the meter.

Then if C_0 is used to symbolise the reading of the variable capacitor at resonance, C_1 its reading at the lower .707 frequency and C_2 the reading at the higher frequency, the Q is given by

$$Q = \frac{C_0}{C_1 - C_2}$$

It may be noticed in the photograph of the prototype instrument that we have added a small line to the meter scale at the .707 position, to facilitate easy reading in making Q measurements. Readers may care to mark their meter in a similar fashion.

The parallel resonant frequency of a quartz crystal may be checked in the same way as that for an LC circuit. However, note that as a crystal has a very high effective Q the peak will be very sharp, and can be easily missed if the oscillator is tuned too rapidly. A good slow-motion tuning vernier on the oscillator or generator is of great help.

If the input to the tester is left at the same level the meter reading will give comparative checks of the activity of different crystals of the same frequency. The third overtone frequency and activity may also be checked with the resonance meter. To do this the crystal is placed in series with the active lead of the signal source to the tester.

Slowly tuning across the overtone frequency will give a reading on the meter. This will be the actual third overtone frequency of the crystal and the meter reading can again be used for comparative activity checks. If the crystals available are known to be accurate in their frequency markings, then it is possible to reverse the test procedure for accurate calibration of a signal generator.

When making tests with this unit it is necessary to allow for harmonics generated by the signal source, and a general rule is to tune from the highest frequency of the signal source down. The first reading obtained will be the correct (fundamental) frequency.

This frequency of the signal source will always give a higher reading than those obtained from harmonics, unless an extremely bad signal source is used. In our tests we did not encounter such an instrument, although some of the cheaper units currently available may possibly fall into this category.

Shortly after finishing this meter it was found extremely useful in plotting responses of a crystal filter used in a single sideband exciter. These are only some of the tests that can be made with our resonance meter and its test functions are limited mainly by the imagination of the prospective user.

LIST OF PARTS

- 1 Standard instrument case, 9 x 6½ x 5½ inches.
- 1 Carrying handle.
- 1 1mA meter, 2½ inches square.
- 6 Terminals, 3 red, 3 black.
- 1 On/off slide switch.
- 1 Bezel.
- 1 Log dial and vernier drive.
- 1 3-pin power plug.
- 1 Length of power flex.
- 1 Two-way connector for power flex.
- 1 9-pin ceramic valve socket.
- 1 Power transformer, 240V AC primary, multi-tapped secondary and 6.3V secondary.
- 1 NE-2 neon.

VALVES & DIODES

- 1 6U8 valve.
- 2 OA210 diodes or similar.
- 2 OA91 diodes or similar.

RESISTORS

(half-watt unless specified)

- | | |
|------------|-------------|
| 1 100 ohm. | 1 47K 1W. |
| 1 1K. | 1 82K 1W. |
| 1 1K 2W. | 1 470K. |
| 1 6.8K 2W. | 1 1 megohm. |
| 1 33K 1W. | |

CAPACITORS

- 2 .0015uF, 400VW plastic.
- 4 .01uF, 400VW plastic.
- 1 .47uF, 25VW ceramic.
- 2 8uF, 350VW electrolytic.
- 3 24uF, 350VW electrolytic.
- 1 100uF, 12VW electrolytic.
- 1 5-100pF variable capacitor.

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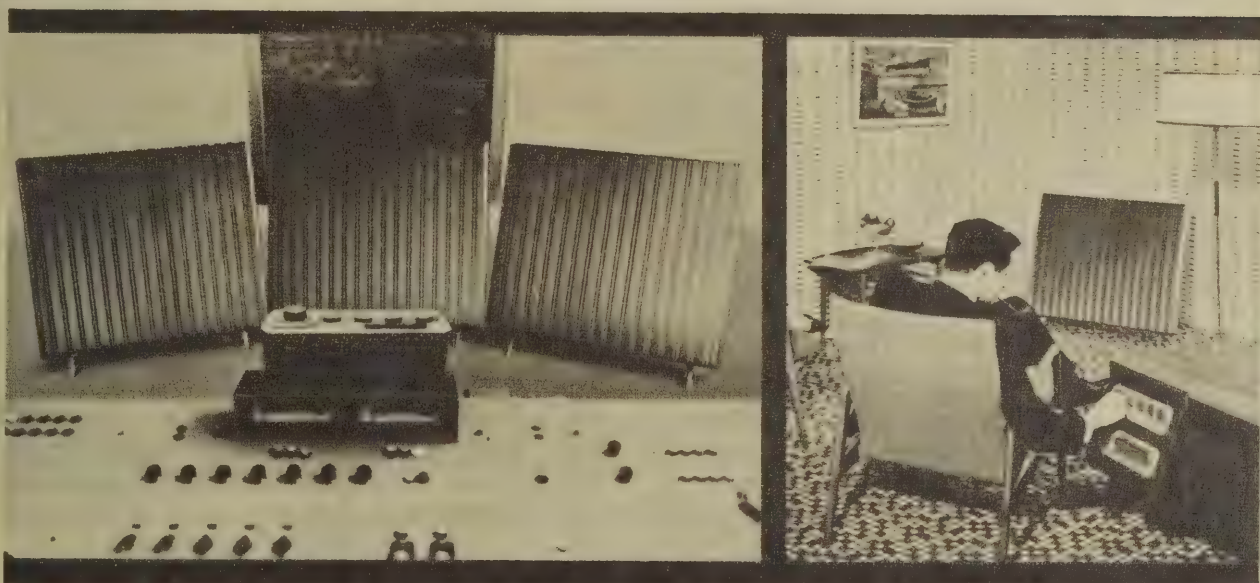
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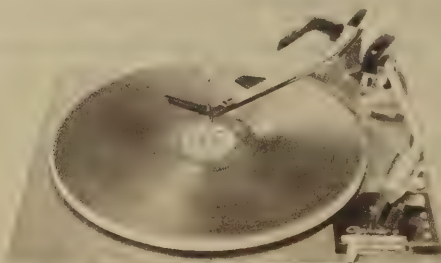
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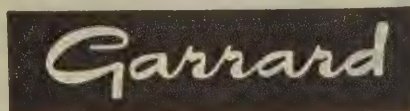
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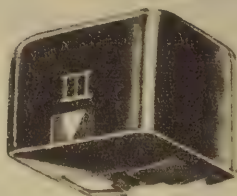
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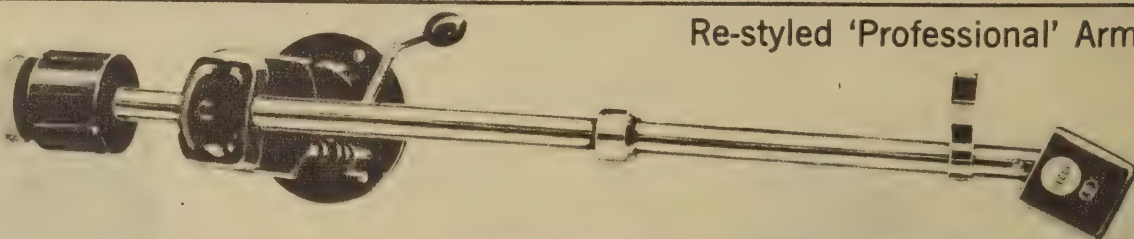
ELLIPTICAL diamond stylus: .0003" $\times$.0008"
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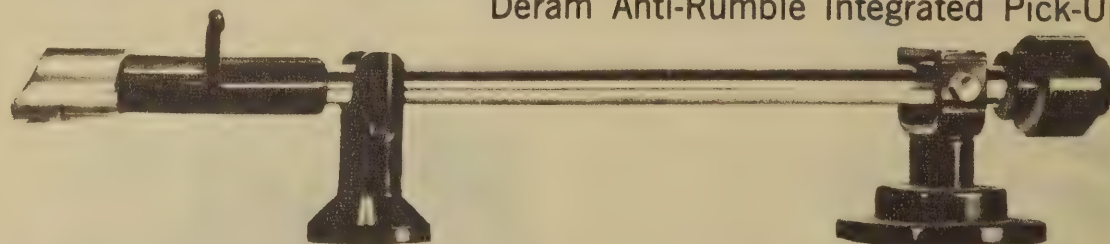
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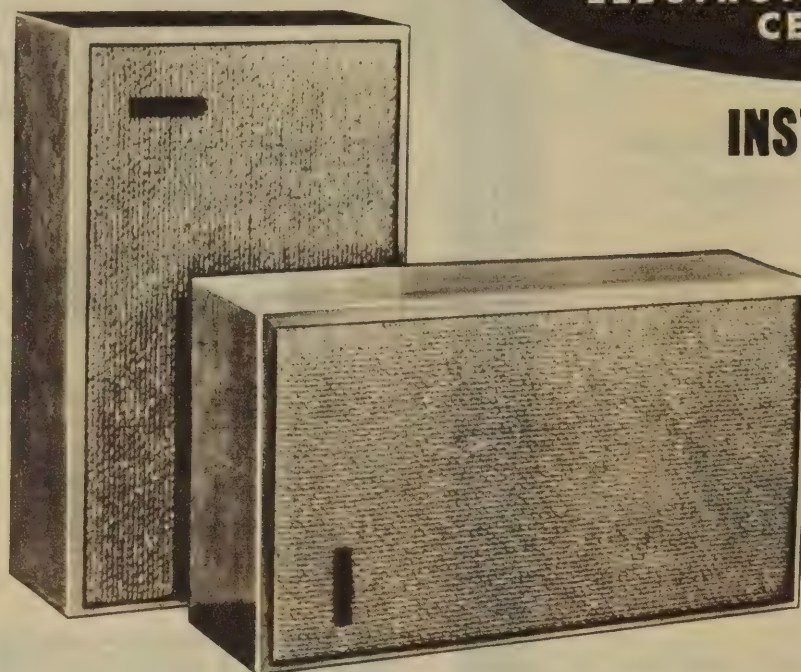
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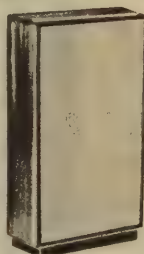
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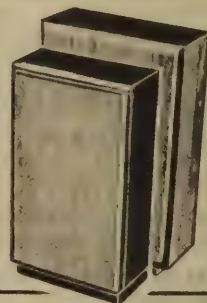


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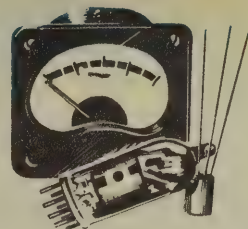
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Basic Radio Course



CHAPTER 24: Modern tape recorders, their construction and operation. Drive systems. Single and three motor decks. Types of motor. Operating speeds. Magnetic heads. Two- and three-head recorders. Pressure pads and alternatives. Azimuth adjustment. Recording and replay equalisation. Recording level indicators. Bias and erase oscillators. Recording interlocks. Stereo recording and replay.

IN the last chapter of this course we discussed the history of magnetic recording, the theory behind it and the structure of recording tape. Using this material and that of previous chapters as background we can now proceed to a more detailed discussion of the construction and operation of a modern tape recorder.

Although to the casual observer a tape recorder may seem to be a single unit, it is most conveniently considered as having two distinct parts: The part concerned with physical or mechanical handling of the tape itself, called the "transport" or DECK, and the part concerned with processing the electrical signals being recorded and played back — the "electronics." Let us first look at the construction and operation of the tape deck—the mechanics.

The principal function of the tape deck is to move the tape smoothly and steadily past the magnetic heads during recording, erasure and replay. Modern decks also allow rapid forward and reverse movement of the tape to permit the easy selection of a particular section of tape and to provide for rewinding the tape after recording or replay.

It is possible to perform these func-

tions in an elementary fashion by simply connecting an electric motor or motors to the spindles used to support and pivot the spools of tape — energising the TAKE-UP spool spindle for forward motion of the tape, or the SUPPLY spool spindle for reverse motion. This system has in fact been used in the past and is still used in many of the very cheap types of battery-powered transistorised recorder.

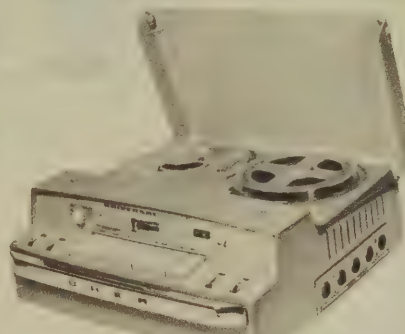
However, this simple drive system has a serious disadvantage. The speed of the tape past the magnetic heads is not constant. Because the tape motion is simply due to the tape being wound on to the take-up spool, the steady rotation of the spool causes a progressive speeding up of the tape as the amount of tape wound on the spool increases.

As a result, it becomes impossible to cut a recorded tape and transpose a section of the recording to another position in the sequence; doing so would mean that the transposed section would be replayed at a different speed to that at which it had been recorded, and the pitch of the sounds would either rise or drop. Even cutting out an undesired section of the recording would disturb the replay speed of the remaining sec-

tions. Tape EDITING is rendered impossible.

But, quite apart from the problem of editing, there is a more serious problem: Tape slippage and uneven winding in the take-up spool cause the tape movement to be jerky and variable rather than smooth and steady. This causes unpleasant intermittent variations in the pitch of the record—the so-called WOW and FLUTTER, referred to in an earlier chapter.

Because of the severe limitations of the simple drive system, recorders intended for serious recording employ a more refined system known as CAPSTAN DRIVE. In this system the tape is drawn past the heads, not by tension



A modern high-quality tape recorder, suitable for either domestic recording or commercial dictation.

from the take-up spool, but by being friction-driven by a smooth, constantly rotating spindle called the capstan.

The diagram shown in figure 1 should help in visualising the essentials of capstan drive. The diagram represents a deck of the type used in many modern domestic machines, employing only one drive motor.

By means of either a pulley and belt system, as shown, or a friction-drive system employing a rubber intermediate wheel, the motor drives at constant speed a spindle carrying a heavy flywheel. The inertia of the flywheel is used to ensure that the spindle rotates extremely smoothly despite possible variations in either the speed of the motor or the loading imposed by the tape.

The top of the spindle forms the capstan. The tape is pressed against the capstan by a sprung rubber PINCH WHEEL, and thus the tape is driven at a constant, steady rate. The take-up spool is driven by a slipping clutch arrangement whereby it does not control tape speed but simply winds up the tape fed to it by the capstan.

When rapid forward motion of the tape is required, in order to select a required section of the tape, the usual procedure is to move the pinch wheel away from the capstan and alter the takeup spool clutch so that it no longer slips. For reverse motion of the tape to REWIND, drive is transferred to

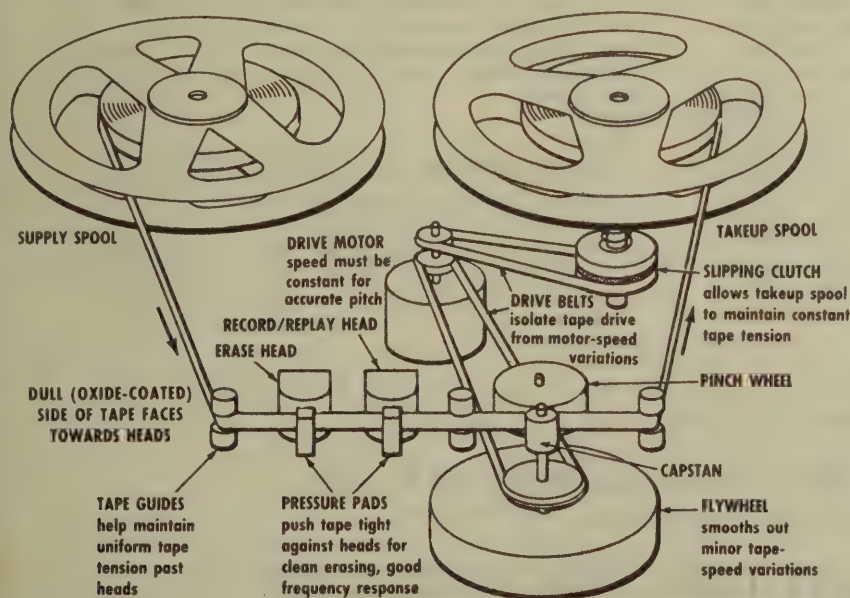


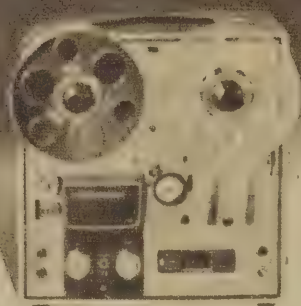
Figure 1: The main parts of a single-motor tape deck, as used in many domestic recorders. The text explains its operation.

AKAI TAPE RECORDER

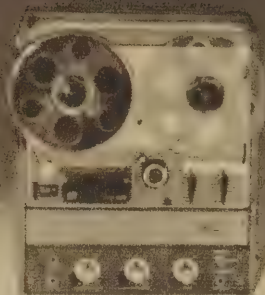
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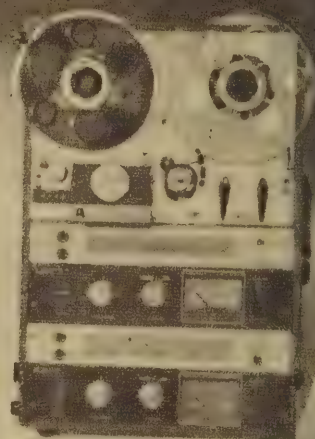
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MODEL 1700



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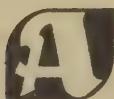
MODEL 910 P.A. SYSTEM TAPE RECORDER * 2 track monaural record and play * 2 speeds (3 3/4" and 7 1/2" per sec.) * Frequency response—40 to 12,000 cps at 7 1/2 ips. * Simple public-address system * Input mixer * Pause lever * Simple change-over for necessary AC power

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the supply spool, again with the pinch wheel moved away from the capstan.

While a single-motor drive system of the type just described is capable of excellent performance, it often necessitates a complex system of pulleys, levers, intermediate shafts and wheels in order to permit the single motor to perform all the required functions. Because of this, some designers adopt an alternative course, using three separate motors. This often permits considerable simplification of the deck mechanism, and it also allows the use in each position of the type of motor best suited for the task. The disadvantage is that the use of three motors proves rather costly.

The diagram of figure 2 shows the essentials of three-motor drive. One motor is used to drive the capstan, and the other two the spools.

It should perhaps be mentioned here that there are other types of drive system besides those shown in figures 1 and 2. There are also drives using two motors, or multiple capstans with sprung loops of tape, or combinations of all these; however, discussion of these systems is beyond the scope of the present course. The two systems illustrated are the most popular drive methods and will serve to illustrate the broad principles.

MOTOR TYPE

Whichever drive system is used, the type of motor or motors used is quite important, as the speed regulation and general performance of the motors determines to a very large extent the quality of the recording. As the tape speed in a capstan-drive system is directly controlled by the capstan drive, the motor responsible for capstan drive is of prime importance in this regard.

The majority of modern tape decks are intended to operate from AC; the choice of motor types is thus between commutator-type motors of the series, parallel or compound type, induction motors and synchronous-induction.

Commutator-type motors are rarely used because of their poor load-speed and voltage-speed regulation. Four-pole, and occasionally two-pole, induction motors are used in decks of the less pretentious domestic variety and for spool drive in professional machines, because of their controllable regulation, reliability and modest cost. For spool drive it is usual to give the motors a poorly regulated or "torque" characteristic, either by running them via a series resistance or by using a high resistance rotor cage.

Synchronous-induction motors are used in the highest quality machines, particularly for capstan drive. In some cases the motor drives the capstan and flywheel via a flexible coupling, as shown in figure 2; in others, via a rubber intermediate wheel. Some further cases employ a motor having an external rotor which acts as the flywheel, and use the motor spindle itself as the capstan.

Battery-operated recorders usually employ small commutator-type motors, either fitted with a centrifugal governor or connected into an electronic speed regulation circuit. The more elaborate professional instruments may alternatively employ a three-phase synchronous-induction motor driven by a transistorised oscillator system.

Most modern recorders operate at a number of speeds. The faster speeds are used where high quality recording is essential, while the slower speeds are used where either tape economy or the need to make a long continuous recording are more important than quality. Standard operating speeds are 15 inches per second (mainly used for professional recording), 7½ips, 3½ips, 1-7/8ips and 15/16ips.

Regardless of the number of motors used to power a deck or the drive system used, some sort of braking system must be employed to bring the spools to a halt smoothly and without tape spillage when it is desired to stop. Either mechanical or electrical braking may be used, electrical braking being performed by applying DC to the spooling motors to convert them into eddy-current brakes.

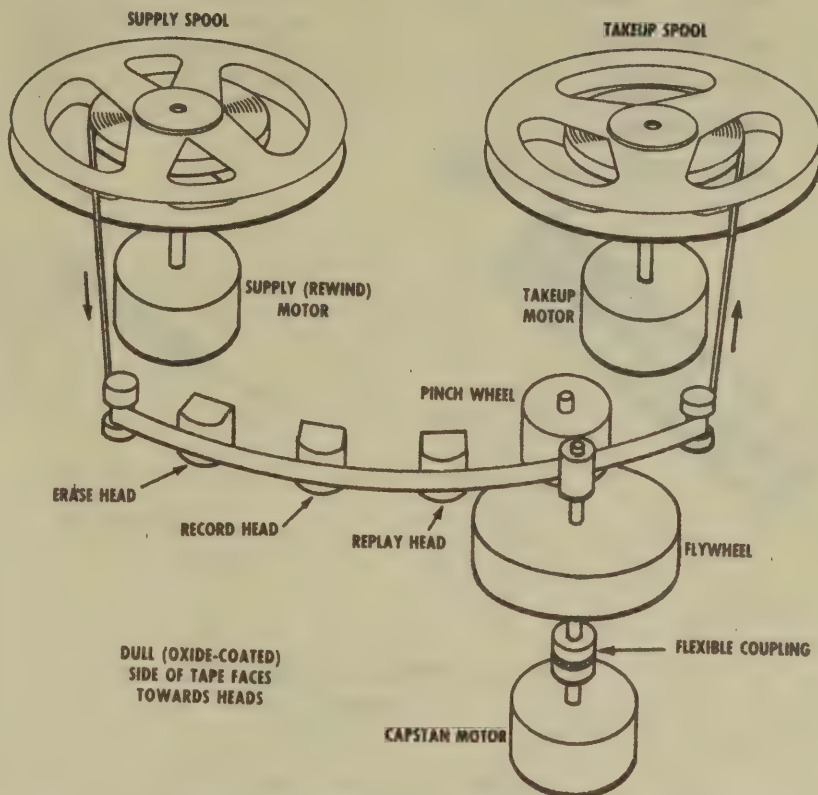


Figure 2: A three-motor deck, as used in the better-quality tape machines. The use of three separate drive motors tends to make the deck simpler mechanically, but increases cost.

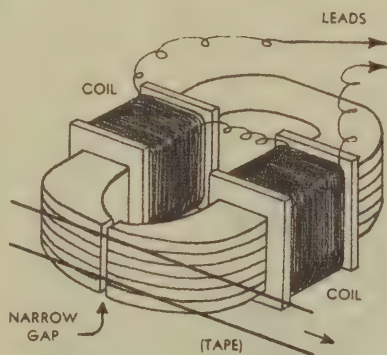


Figure 3: The basic construction of a magnetic head.

Where a pulley-and-belt or intermediate wheel capstan drive system is used it is common to provide the various speeds by arranging a stepped-diameter motor pulley to provide different drive ratios. In recorders where the capstan is directly driven either the motor is arranged to run at different speeds using electrical pole-changing, or interchangeable capstan bushes are provided, each of a different diameter and providing a different tape speed from the fixed motor speed.

Light braking is also applied to the supply spool spindle during normal recording and replay, to keep the tape under tension and prevent free-wheeling.

Having looked at drive systems let us now turn to the magnetic heads. As we have seen from previous chapters these are small electro-magnets, having a narrow "air-gap" over which passes the magnetic oxide coating of the tape. The basic construction of a tape head is shown in figure 3.

The "closed-C" configuration of a magnetic head arises from the need to achieve an efficient magnetic coupling with the tape oxide, and also from the desirability of scanning at any one moment a relatively small section of the oxide — the latter for reasons which will be made clear shortly. A bar magnet construction would be capable of only loose coupling with the oxide, and it would also tend to couple with a fairly long section at any one time; apart from this it would tend to be disturbed by ambient magnetic fields because of the "open" nature of the magnetic path.

The width of the gap in figure 3 is greatly exaggerated for clarity. The gap of practical heads is often barely visible, if at all. It should also be noted that although the gap is often called an "air-gap," an open gap is rarely used as this



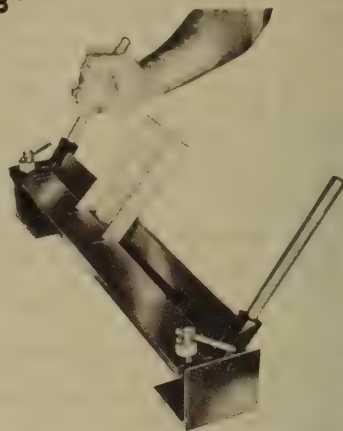
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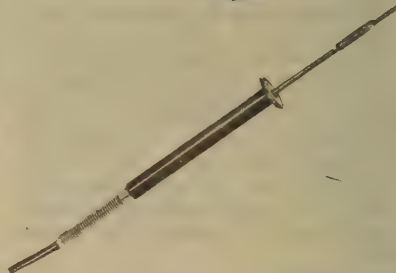
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would tend to clog up with dirt and oxide particles. Usually the gap consists of a shim of non-magnetic material such as beryllium copper alloy, selected for its wear resistance.

As indicated in figure 3 the core of a magnetic head is often made from thin laminations of a magnetically "soft" material such as mu-metal. Laminations are used for the same reason that they are used in power transformers — to reduce eddy-current losses. Another way of reducing such losses is to use a core made from a ferrite material, although to date such cores have been used only in erase heads because the provision of an extremely narrow gap proves to be rather difficult.

There are three separate functions performed by the heads—erasure, recording and replay. The three functions may or may not be carried out by three separate heads, as we shall see a little later on; for the present, however, we shall look a little closer at the functions and the type of heads best suited to perform them.

In the last chapter we saw that super-sonic AC erasure involves taking the magnetic oxide particles through an expanding series of hysteresis loops to saturation in both directions, and then back down through a series of contracting loops until they have effectively zero remanence.

For efficient erasure, then, the oxide must (a) be taken to saturation in passing the erase head gap, and (b) stay long enough in the field of the gap to be cycled through a fairly large number of loops. These requirements are best met in practice by keeping the frequency of the erasing head signal below about 80KC (above this becomes too hard to develop enough magnetic induction), and by making the gap of the head relatively wide — at least .001in. and sometimes as large as .02in. Note the term "relatively wide;" the erase head gap is still quite small, although it is many times larger than the gaps used for recording and replay.

The requirements for a recording head are somewhat similar to but slightly different from those for an erase head. Although a record head must be able to produce a fairly high flux density throughout the tape oxide, for which purpose alone a fairly wide gap is desirable, less power is conveniently available for the purpose than for erasure. This usually means that a gap used only for recording should be somewhat narrower than for erasure, a typical recording head having a gap of approximately .0005in.

The requirements for a replay head are different again from those for either an erase or record head. The main difference is that the width of the gap for replay must be as small as possible in order to obtain acceptable high frequency response.

The reason for this is as follows: For a constant tape speed, the length of tape occupied by a full cycle of a recorded signal is inversely proportional to the

signal frequency; a cycle of low-frequency signal will occupy a relatively long section of tape, while that of a high-frequency signal will occupy a short section. The actual length will be given by the tape speed in ips divided by the frequency in cps: thus at 7½ips one cycle of 100cps tone will occupy .075in while that of a 10KC tone will occupy only .00075in. Lower tape speeds will give correspondingly shorter recorded cycles.

Now to reproduce a recorded signal of a given frequency the gap of the replay head must be somewhat narrower than the length of tape occupied by the

otherwise be. However, this tends to produce a fairly bulky head and one which tends to be sensitive to stray hum fields from motors and transformers.

The alternative professional practice is to use a replay head having only a few turns of wire, connected to a shielded step-up transformer. The output of the transformer may be little more than that delivered by a high impedance replay head but, because the head itself has only a few turns of wire, it may be made quite small physically and the overall sensitivity to external hum fields is reduced, despite the fact that the induced hum is stepped up with the signal. This approach is rather more costly than that using a high-impedance head, as shielded step-up transformers are quite expensive items.

As may be seen from the foregoing, the optimum requirements for heads to perform the functions of erasure, recording and replay are somewhat different. Because of this, the highest quality recorders use three separate heads, each one of the appropriate construction. This also offers other advantages—one is that it is possible to monitor a recording being made by replaying it, at the same time, with the separate replay head.

However, because magnetic heads are rather expensive to produce, designers of domestic recorders usually effect a worthwhile compromise between performance and cost by combining the recording and replay functions in a single head. Thus the majority of domestic recorders have only two heads, an erase head and a record-play or "R/P" head. The R/P head is designed with a gap narrow enough to give acceptable frequency response on replay, yet wide enough to make it possible to achieve the required flux densities in the tape oxide during record, using moderate power levels.

An essential of the tape recording process is that the tape oxide makes an intimate and reliable contact with the head gaps. If this is not obtained, the recording quality suffers greatly, with very poor signal-to-noise ratio and serious loss of high frequencies. For example, a separation between oxide and gap of only .00025in on replay will reduce the output at 7KC to approximately one-quarter of its full value at 7.5ips.

The most usual method of ensuring adequate contact is by using so-called PRESSURE PADS, as shown in figure 1. These are spring-loaded levers having small felt pads, being arranged to press the tape against the heads during recording and replay.

Although pressure pads ensure that the oxide and head gap remain in reliable contact, they can produce excessive wear of the heads. This arises from the difficulty of adjusting the springs on the pads so that the pressure is no more than is absolutely necessary.

Because of this, some designers elect not to use pads, arranging instead that the desired contact is achieved by mounting the heads so that the tape is pulled past them in a hyperbolic curve. Providing the tape is kept under tension, the inward pull of the tape itself provides sufficient contact pressure.

Apart from oxide-gap contact, there is another factor which in practice proves to have an important bearing on the quality of recording and reproduction. This is the angle between the long dimension of the head gap and the direction of tape travel, called the AZIMUTH.

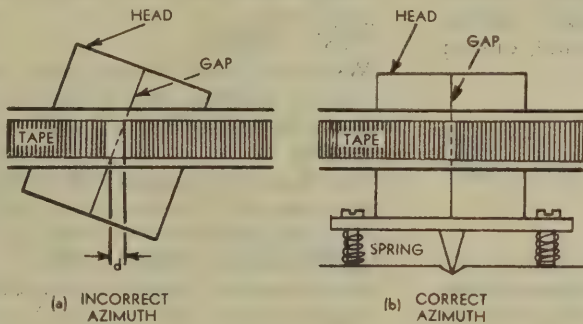


Figure 4: Illustrating the meaning of head azimuth, its effect and adjustment. Correct azimuth is essential for high-quality reproduction.

recorded cycle, because the head can only sense changes in the magnetic field induced in the gap as a whole. If the width of the gap is comparable with the length of the recorded cycles the gap will at any instant scan a large portion of the recorded cycle, and will respond only to the average effect of the portion.

Thus at that frequency where the gap width is exactly equal to the length of a recorded cycle the replay head will have zero output because at every instant the gap will scan a complete cycle of the recorded signal—and the average value of a complete cycle is zero.

From this it can be seen that a replay head with a gap of .00075in would be able to reproduce easily a 100cps signal recorded at 7½ips, but would be useless for reproducing 10KC at the same speed. In fact, its response would probably be unacceptable even at 7KC; to reproduce signals up to 10KC adequately it would be necessary to reduce the gap to approximately .0003in. The use of lower tape speeds makes it desirable to use an even smaller gap, say .00015in or better.

IMPEDANCE

Whereas heads intended solely for erasure or recording may be made in almost any convenient impedance, as dictated by such factors as the number of permissible turns on the coils, available drive current, and so on, the impedance of a replay head is dictated by signal-to-noise considerations. There are two alternatives, one usually adopted in the more modest recorder and the other in professional machines.

The designer of the domestic recorder usually elects to use a high impedance head having many turns of very fine wire. In this way he produces a relatively large head output (but still only a few millivolts) which makes amplifier noise less of a problem than it might

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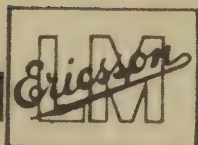
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To see why this is important, consider the case where the head used to make a particular recording has its gap perpendicular to the direction of tape travel. If we use the same head for replay, all will be well; similarly if we use another head for replay we will obtain high-quality reproduction **providing** the gap of the second head is also perpendicular to the direction of tape travel.

However if we attempt to replay the tape using a head with its gap at another angle, as shown in figure 4 (a), reproduction will be very poor — particularly at high frequencies. This is because different sections of the head gap will scan different parts of the recording; the effect will be very similar to that

not always there is a wheel or button to enable the counter to be reset to zero.

Let us now turn to the electronics section of a tape recorder. This comprises two main sections: the amplifiers and the bias/erase oscillator. There is also a power supply to operate these sections, but this will not be considered here.

Amplification must be performed within a tape recorder during both recording and replay. During recording it is required to boost the small signals from a microphone or gramophone pickup to the point where they have sufficient amplitude to operate the recording head; during replay it is required to boost the tiny output of the replay head

to the point where it can operate a loud-speaker.

In elaborate recorders, these functions are performed by two separate amplifiers as in figure 5 (a); this is in fact desirable where three heads are used. However in most domestic recorders economy dictates that a single amplifier is used for both functions. The input and output of the amplifier are switched to the appropriate points, as shown in figure 5 (b).

With either system it is necessary to employ frequency correction or **EQUALISATION** along with amplification during both recording and replay. This is necessary in order to compensate for various losses in the recording and replay processes and arrive at a system which produces a replay signal which is a faithful copy of the signal originally recorded.

Losses occur in the recording head and recording process which degrade the high frequencies more than the low frequencies. For this reason it is usual to apply a certain amount of treble boost or **PRE-EMPHASIS** to the signal during recording.

During replay, both bass and treble boost must be applied to produce properly balanced reproduction. Bass boost is necessary because the output from a replay head is fundamentally proportional to rate of change of recorded flux density and, accordingly, rises with frequency; treble boost must be applied because of head losses and falling response as the gap width approaches the length of a recorded cycle at high frequencies.

Strictly, both recording and replay equalisation must be changed for each

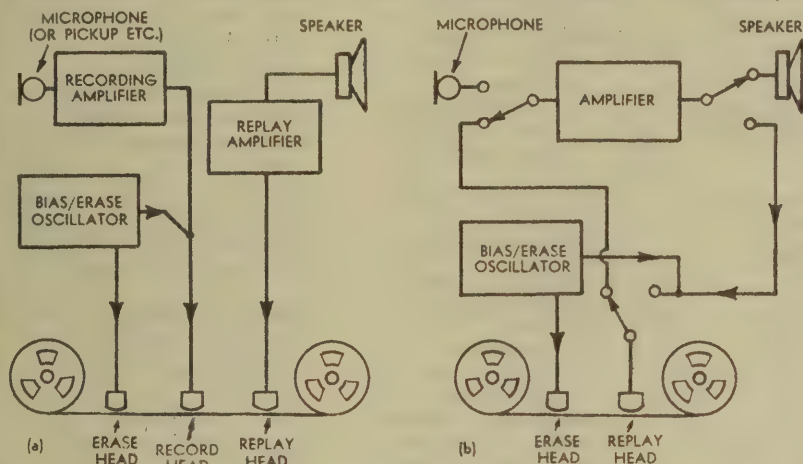


Figure 5: Block diagrams illustrating the operation of two-head and three-head recorders. Domestic recorders are usually of the two-head variety.

which would be obtained with a head gap as wide as the scanned section of tape "d."

For optimum recording quality, then, it is essential that the recording and replay head gaps are both at the same angle relative to the direction of tape travel. In practice this means that all heads of all recorders are adjusted to have a standard azimuth, in order that a tape recorded on any machine may be replayed on any other machine. The standard azimuth is 90 degrees to the direction of tape travel.

The standard way of providing for azimuth adjustment is to use a head mounting like that shown in figure 4 (b). The head is supported on a knife-edge sitting in a groove. It is tilted and clamped at the appropriate angle by means of the small screws and springs. Azimuth adjustment is often omitted on erase heads as these are not as critical as record and replay heads; a fixed mounting is found sufficiently accurate.

Before we pass to the electronics side of tape recorders one or two small points about decks may be mentioned.

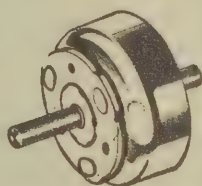
Often decks are fitted with an "instant stop" or **PAUSE** control, to permit the tape to be stopped for a short period without turning off the power to the motors. Typical pause controls simply lift the pinch wheel away from the tape and capstan; they may or may not allow for latching the pinch wheel in the retracted position for extended pauses.

Many tape decks have a tape position indicating device consisting of a series of counter wheels or a geared dial operated by a belt and pulley system from one of the spool spindles. Usually but

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- 87 "R" Decade Box
- 88 "C" Decade Box
- 89 Electronic C.R.C. Switch
- 90 Geiger Counter

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- 92 DXERS (Batt.) 2
- 93 DXERS A.C. 2
- 94 DXERS A.C. 3
- 95 DXERS 3 Band 3
- 96 Little General 1961
- 97 Interstate 5
- 98 1962 Stereogram
- 99 Fremodyne 4
- 100 Amateur RX
- 101 Transistor 1
- 102 Transistor 2
- 103 Transistor 3
- 104 Transistor 4
- 105 Transistor 5
- 106 Transistor (R.F.) 7
- 107 Transistor 8
- 108 Transistor 3 Band 8

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- 110 Remote V.F.O. 1963
- 111 144 MC/S A.M. TX
- 112 144 MC/S S.S.B. TX
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operating speed and, in the more elaborate recorders, this is done. However, it may not be done in recorders of the cheaper variety, the designer saving on switch wafers and components by adopting values of equalisation which give satisfactory—though not necessarily optimum—operation at a number of speeds.

Apart from the need for providing and switching equalisation circuitry and the need for switching amplifier inputs and outputs for recording and replay, tape recorder amplifiers employ fairly standard circuitry. However, special care must usually be taken with the input or

head. In fact, unless the erase head is well designed it is difficult to achieve satisfactory erasure above about 50-60KC.

The conflict between bias and erase frequency requirements usually results in a compromise, as both are usually generated by the one oscillator and must accordingly be the same frequency. In recorders of the cheaper variety the compromise frequency is often around 50KC, while in semi-professional recorders it may be 80KC or even 100KC where a high-quality erase head is used.

In the most elaborate recorders, where

The button may work a mechanical lock or stop via levers, or it may be a switch which completes the circuit to a relay.

In some professional machines there is no interlock of this type, but a switch at the back of the machine which can only be turned using a removable key. This makes the recorder quite "safe" where non-technical operators must use the machine to replay valuable tapes.

To conclude this chapter we should perhaps mention stereo tape recorders, which permit simultaneous recording and replay of the two channels of a conventional stereo signal.

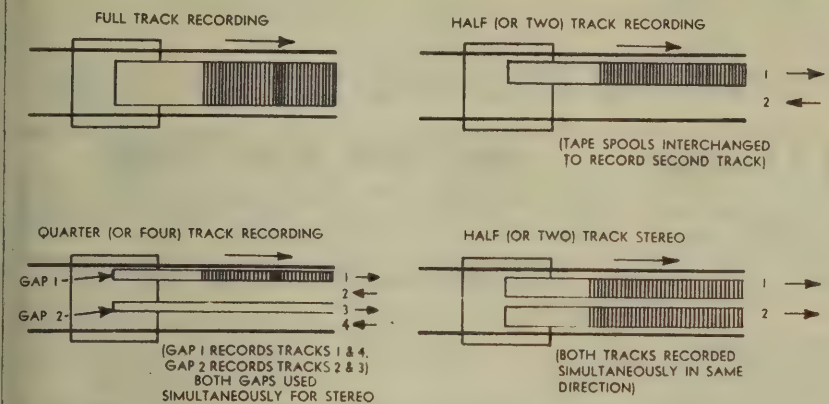


Figure 6: The various track systems in common use. These were discussed in chapter 17, of December, 1964.

preamplifier stages to keep hum and noise to an acceptably low level.

During recording it is important that the recording level be kept high enough to obtain a sufficiently large signal-to-noise ratio yet below the point where tape or head saturation cause distortion. A recording level monitor is therefore provided.

In domestic recorders of the simpler variety this may simply be a neon lamp or pair of neons arranged to glow at appropriate signal levels. Some recorders use "magic eye" indicator tubes for the same purpose, while professional recorders usually provide a moving coil meter whose needle moves proportionally to either the peak or average value of the recording signal.

In most recorders supersonic bias and erase voltages are generated by a valve or transistor oscillator circuit. The oscillator is usually arranged to feed supersonic signals directly to the erase head, but indirectly to the recording head by way of a variable control. This allows the user to find the optimum value of bias for the particular tape used.

During the recording process there is a tendency for the supersonic bias and the high frequencies in the recording signal to beat or heterodyne together to produce distortion and "chirps." Because of this tendency, the bias frequency is made as high as possible so that any beats produced will tend to be supersonic and inaudible. A bias frequency of at least 80 to 100KC is usually considered necessary to reduce this effect to a satisfactory minimum.

This often raises problems where the erase function is concerned, as it is hard to achieve efficient erasure at such high frequencies due to losses in the erase

essence a stereo tape recorder is simply two recorders in one, recording and replaying adjacent tracks on a single ribbon of tape. However, in practice, a stereo tape recorder tends to be a fairly complex piece of equipment.

Part of the reason for this is that stereo involves additional controls, over and above those for two mono recorders—such as balance controls and channel reversing facilities. Also it is usual for the designer of a stereo tape recorder to provide for mono recording and replay on either of the two tracks separately, and this involves extra switching. Again the designer may include more extensive input signal mixing facilities than in common mono recorders, as mixing is more essential in producing a worthwhile stereo recording.

One of the main reasons for the current popularity of stereo tape recorders is the growing number of pre-recorded stereo tapes available, competing with the microgroove disc as a medium of home entertainment. Although stereo tapes tend to be less convenient, somewhat noisier and rather more costly than discs, they offer extended frequency response and improved channel separation.

To replay pre-recorded stereo tapes it is not necessary to have a complete stereo recorder, however. Thus many audio enthusiasts elect to take simpler and less costly alternatives, such as a "replay only" tape deck-and-replay pre-amp combination connected to their existing stereo system, or a recorder having only mono recording facilities combined with facilities for stereo replay.

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PERFORMANCE DATA	PC1	PC2	PC3	PC4	PC5	PC7
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Input Sensitivity mV	100	2	10	200	5	5
Input Impedance Ohms	1.5K	1K	2.5K	220K	1.5K	1.5K
Load Resistance Ohms	40	15	15	15	3	8
Supply Voltage Volt	9	9	9	9	12	9
Total Distortion %	6	6	6	6	3	3
Frequency Response cps	330—15K	200—12K	200—12K	200—12K	50—15K	50—15K

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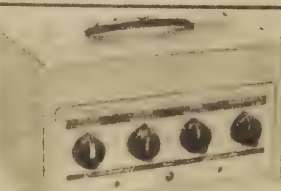
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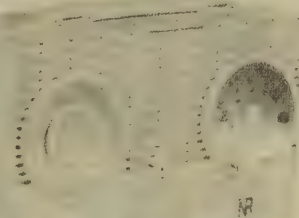
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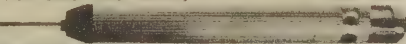
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3 1/2in Per Mag	22/6	6in x 9in Per Mag Hvy. dty. 15 ohm	42/6
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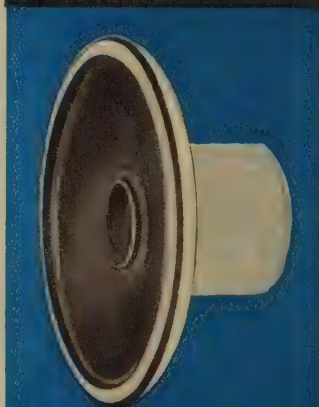
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TYPE 225HB
RESONANCE: 350 cycles
RESPONSE: 300-4,000
VOICE COIL IMPEDANCE: 8 ohm
POWER HANDLING ABILITY (PEAK): 250 mw
TOTAL GAP FLUX: 9,800
AIR GAP FLUX DENSITY: 6,000
BAFFLE OPENING: 2" round
MAXIMUM DEPTH: 1"



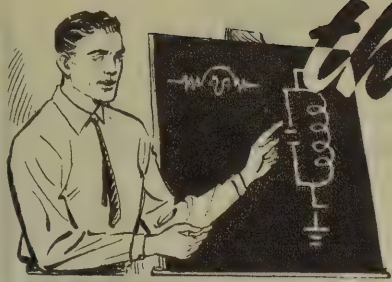
TYPE 225JB
RESONANCE: 350 cycles
RESPONSE: 300-4,000
VOICE COIL IMPEDANCE: 8 ohm
POWER HANDLING ABILITY (PEAK): 300 mw
TOTAL GAP FLUX: 10,000
AIR GAP FLUX DENSITY: 7,000
BAFFLE OPENING: 2" round
MAXIMUM DEPTH: 1"

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the "Answer Man" Explains

Ignition systems, micromodules . . .

Discussion starts, this month, with an argument about the polarity of auto ignition systems. Then abruptly it moves to one about these new-fangled miniature circuits and a lament for the good old days!

A friend of mine suggested the other day that the polarity of the spark in a car's ignition system was important. I said I didn't see how it could be, since it was simply a matter of having enough voltage to jump the spark gap. The voltage surely didn't care which way it jumped!

I'm afraid your friend has the right idea on this one, at least in relation to ordinary ignition systems. The polarity of the high tension voltage does make a difference, and for a reason that isn't too far removed from the heart of electronics.

You are probably well aware that the flow of electric current can be equated to the movement of electrons around a circuit, and that electrons are attracted by a positively charged body.

Most likely, you are also familiar with the idea of electron emission, seen to best advantage in an ordinary radio valve. At the cathode, electrons acquire energy by reason of the applied heat and, attracted by the positive potential on the anode, jump across the intervening space.

The construction of an auto ignition plug is such that its insulated centre electrode operates at a much higher temperature than the other electrode, which is attached to the body of the plug. Being so attached, it has a direct heat conduction path to the plug body and thence to the mass of the cylinder head.

While it is a far cry from a radio valve to an auto spark plug, it is nevertheless true that electrons can be launched across the gap more readily from a hot, negatively charged centre electrode to the plug body rather than in the reverse situation — where they have to be launched to a positive centre electrode from a relatively cool electrode.

For optimum ignition, therefore, the polarity of conventional systems is always arranged so that the initial major pulse at the spark plug centre electrode is negative-going.

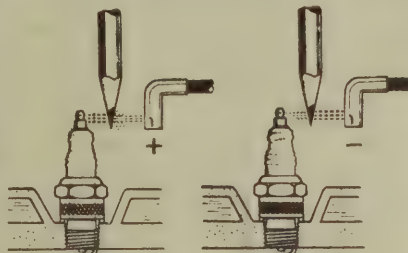
In fact, this point was discussed in one of the well-known "Gus" stories in a recent issue of "Popular Science."

The veteran character was quoted as saying that up to 45pc more voltage is required to achieve the same order of spark from the reverse connection, as compared with the correct connection. The reason, as we have said, is simply that electron emission is harder

to promote from a cool electrode than from a hot one.

In a practical situation, where a certain secondary voltage is available, a reverse connected system will falter more readily than one which is connected correctly. At low engine speeds, anything which further impairs the efficiency of the system will lead more readily to rough running; at high engine speeds, where compression goes up and the dwell period diminishes, the spark tapers off more rapidly and may set a limit on maximum rpm.

While it can generally be assumed that new vehicles will all be correctly



WRONG
An old trick but a useful one. Feathery sparks or a flare to one side or other of the pencil lead indicates right or wrong spark polarity.

RIGHT

wired and polarised, mistakes may well occur in vehicles which have been carelessly serviced, rewired or fitted with odd ignition coils. And there is certainly scope for error.

For example, an ignition coil may be clearly marked "Dist." and "Batt." without ready means of verifying whether it is for a vehicle with the negative or positive side of the battery connected to chassis.

Again, the coil may have one particular low voltage terminal marked "+," but leaving room for uncertainty as to whether this means true battery "+," irrespective of earth strapping, or simply battery active, irrespective of polarity!

Getting things round the wrong way will not prevent the vehicle from running, but it can rob the system of efficiency (1) because it takes no advantage of natural plug electrode emission; and (2) because the primary voltage no longer adds to the secondary voltage.

We are indebted to "Gus," as above-mentioned, for the little drawing reproduced herewith. Hold an ordinary pencil — keeping your finger off the top of the lead — in the path between a plug cap and the lead to it. According to "Gus," you can readily pick the right from the wrong.

Everyone seems to be talking, these days, about printed circuits, modules and such

like. What's wrong with the good, old-fashioned way of doing things? One at least had room to work on the circuit and replace parts!

In the old-fashioned days, the old-fashioned ways were appropriate enough, but circumstances change with the years, whether we like it or not.

Prewar, in this country at least, the output of the electronics industry consisted mainly of radio broadcast receivers, using from four to six valves. Though the sets varied a good deal in shape and size, the internal circuitry followed fairly common conventions and, by modern standards, was not very imposing in either quantity or complexity.

These prewar receivers, plus any other items, were built in the only way the industry then knew — by hand assembly, hand wiring and subsequent individual inspection and testing.

There were many primitive aspects to the exercise, as those will remember who worked through it. There was a floating population of assemblers and wirers, who worked hard during the winter to pro-

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vide for the summer slack-off that would inevitably follow. There wasn't too much argument about awards and working conditions—at least not in terms that made man-hours prohibitively costly. When manufacturers needed to turn out more receivers, they simply put on more process workers—temporarily!

The primitive conditions were often reflected in the quality of the workmanship. While there were good assemblers, there were lots of others who persistently tightened things too much or not enough.

There were wiremen who made more than their share of "dry" solder joints; others who made very "wet" joints by using too much flux or the wrong kind of flux, leaving a residue in hidden crevices to corrode adjacent metal or provide a breakdown path some time later.

There were the lead-stretchers, the pig-tail twisters, the strand cutters and so on, each building his own individual faults into the receivers that passed through his hands.

Components, too, had more than their fair share of built-in faults due, as often as not, to manufacturers' failure to appreciate the insidious effects of chemical impurities.

Naturally enough, those whose job it was to maintain reliability did their best to anticipate or intercept both operator and component faults but, if their efforts kept the failure rate to a practical figure, it was partly due to the relatively few components and wires involved and the relatively simple matter of providing service when things did go wrong.

When factories switched to wartime production, a new set of circumstances arose. The floating population of process workers disappeared, circuit complexities began to multiply, field conditions became far more onerous and the pressure was on to cut the failure rate drastically. Many components and practices which seemed almost traditional were shown to be undesirable and the search was on in earnest for components and techniques which would yield greater uniformity and reliability.

POST-WAR PERIOD

The lessons learned during the war paid off in the following years when manufacturers faced up to the production of television receivers. The position would have been quite untenable had the potential causes of failure in prewar radio receivers simply been transferred into television and multiplied in the ratio of the parts and connections involved.

As it was, the position proved to be bad enough and manufacturers in this country and overseas alike have since been involved in a constant struggle to achieve improved reliability while, at the same time, keeping their prices at competitive levels.

One result of this has been a gradual shift from bad methods and the "human error" element to mechanisation.

The printed wiring board represented a giant stride in this direction because, at one stroke, it virtually eliminated wiring errors, made possible automatic and critically controlled soldering, took care of assembly problems as a bonus, and facilitated jig testing of sub-assemblies.

To be sure, printed boards have themselves had their share of troubles but all of these are accessible to im-

proved techniques and firmer quality control.

The printed board approach is especially attractive in transistorised equipment, with the elimination of friction fit sockets.

There is little doubt that the modern transistor portable owes its small size and relative cheapness to printed wiring and mechanised production and the

A technician at Litton Industries' Advanced Circuitry division, in Missouri, inspects what is probably the largest printed wiring board in current production. One-sixteenth of an inch thick and printed on both sides, the board is nearly four feet long. The boards are designed for use in electronic organs.



very popularity of these sets rather begs the question as to whether particular individuals like the way they are built.

The module concept is a further step but it is really nothing new. After all, the dual-wave brackets, which were commonplace even before the war, were really modules, separately assembled, wired and tested—even if by hand methods.

And every TV turret and TV IF strip is likewise a module.

What is happening now is simply that more "chunks" of circuitry are being separated and made the subject of individual mechanised production and testing. The reasons behind this move are practicability, uniformity, reliability and economy.

And these add up to pretty powerful arguments!

Micromodules have come about as a natural extension of this thinking and as the result of certain other very powerful influences—notably the need to pack more involved circuitry into an absolute minimum of space in aircraft, missiles and space vehicles and, on the ground, into computer-type equipments of one kind or another.

As matters are turning out, manufacturers who have learned to cope with the microscopic dimensions of transistors now find that they can, with equal facility, turn out complete pieces of circuitry including resistors and capacitors, as well as diodes and transistors, on microscopic "chips" of semiconductor material. The fantastic detail in miniature is best illustrated by examining this month's front cover.

No less important than the diminutive size of these micromodules is the fact that they promise to be more reliable and, in the long run, cheaper than equivalent pieces of circuitry mass-produced by other means.

For military and space applications micromodules are a must if "progress" is not to be impeded.

For computer and certain other applications, where large numbers of stan-

dardised circuit groups are required, the module concept has special advantages and micromodules have a further attraction.

For mass-produced "entertainment" units, printed wiring boards and sub-assemblies offer important advantages. More advanced modules and micromodules may find application later.

In fact, considering the number of

other items one sees with printed boards and modules—test equipment and even do-it-yourself projects—it is hard to avoid the conclusion that "the good, old-fashioned way of doing things" is very much in the decline.

One thing is fairly certain, however. Manufacturers usually don't elect to use particular techniques for the mere fun of it. If they use printed boards, modules or micromodules, there is usually a very good reason for so doing.

And, in the cases where they—or we—prefer the conventional approach, there is usually good reason, likewise, to do so.

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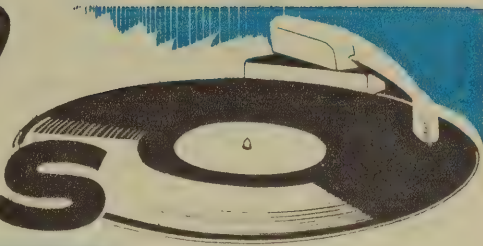


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AUDIO TOPICS



ELECTRONIC MUSIC

New electronic techniques add new and different dimensions to the art of musical composition. They challenge listeners, as well as composers.

IN eighteenth-century Europe, the tools a court composer needed were relatively simple: quill, paper, harpsichord, and a knowledge of harmony and counterpoint. Now, two centuries later, life has become more complicated for the creative musician, especially the composer of electronic music. The tools of his trade are amplifiers, tape recorders, electrostatic loudspeakers, oscillators, filters, sine-wave and square-wave generators, toggle switches, and an engineer's know-how.

As the last third of the twentieth century gets under way, the electronic composer (this term will be used repeatedly, despite the fact that blood—not alternating current—courses through the composer's veins) has virtually unlimited horizons of sound to explore. Like Relay and moonprobes, electronic music belongs to the here and now.

Electronic music may be defined as music composed on magnetic tape for performance through loudspeakers, either in the concert hall or at home. Like it or not, this new art form makes it possible for a music lover to go to a concert and see nothing but the rest of the audience, the ushers, and two lonely loudspeakers on a stage that on another night might accommodate from one to 100 performers.

Some composers try to overcome this dehumanising effect by combining tape music with live performance.

The first thing that must be made clear about electronic music is that it is not an isolated or singular attitude or style of music intended for special uses, places, or audiences. It is, rather, a revolution of immense portent that is concerned with the fundamentals of music itself—pitch, tone, rhythm, timbre. It is a new medium that is available to any composer.

Another thing that must be made clear about electronic music is that it is not designed to reproduce or imitate the past. Electronic music speaks out in its own way and with new materials and structures.

As composer Milton Babbitt, of Princeton University, puts it, electronic music makes it possible for the composer to begin at the very beginning and to control every aspect of the creative process from original concept to the final shaping of the musical work of art.



Miss Daphne Oram, a trained engineer and trained musician, who lives in Fairseat, Kent, England, displays her "tools of trade" as a modern composer. Sounds on tape are selected, modified and mixed, "like an artist mixing paint."



In this console, in the B.B.C.'s Radiophonic Workshop, "raw elemental sounds" are manipulated on to composite tapes, which then provide the background for B.B.C. radio and television productions.

To the electronic composer, the predetermined sounds of the conventional orchestra — strings, brass, woodwinds, percussion — are limiting and frustrating. He uses them, of course, but he is also able to escape their confines when he wishes, just as Alexander Calder, the father of the mobile, was able to free himself from the limitations of immobile sculpture. The electronic composer must virtually compose each individual sound.

The introduction of electronic music does not mean that in the near future symphonies by Beethoven or Tchaikovsky will be discarded.

Richard Rodgers, Samuel Barber, Aaron Copland, Dmitri Shostakovich, and Benjamin Britten are not going to abandon their characteristic styles of composition. The orchestras and the opera companies are not going to close down.

The machine will not become king.

However, it is most likely that audiences will hear an increasing amount of music that is either partially or entirely electronic in origin. To some listeners, electronic music now seems merely a whoosh, a beep, a bloop, and a hum — no more musical than the sounds emanating from the radio shack at the nearest airport. Admittedly, a lot of electronic music is inferior stuff, worth no more artistically than the Morse code. But much of it is valuable and has a flair, coherence, and profundity all its own.

It may not be long before the works of Beethoven, Tchaikovsky, Copland, Shostakovich, and other traditional composers will be presented in conjunction with the works of such leading electronic composers as Karlheinz Stockhausen, Edgar Varese, Babbitt, Vladimir Ussachevsky, Otto Luening, and Luciano Berio. In some musical centres of the world this is already fact, not mere prediction.

Will this present an insurmountable problem for the twentieth-century listener? It shouldn't. Even the most casual music lover will go to a concert and hear music of the eighteenth, nineteenth and twentieth centuries in one sitting and think nothing of it. It matters not to him that Mozart turned his back on the baroque style of Bach, or that Wagner and Debussy many years later had to chart new paths as well, each in his own way. The twentieth-century listener takes them all in one gulp and loves it — because of familiarity.

The difficulty lies in developing that familiarity. It is primarily a question of attitude, as Jacques Barzun, author, critic, and Columbia University Provost and Dean of Faculties, remarked to an audience attending a concert of new electronic music produced at the Columbia-Princeton Electronic Music Centre in New York:

"What then is the decent, reasonable

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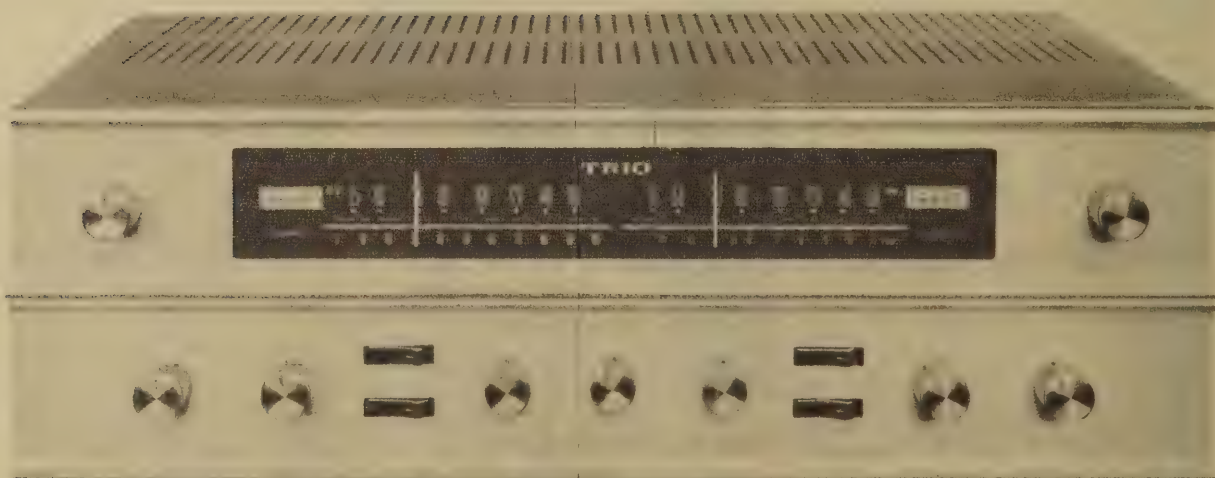
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ELECTRONICS Australia, November, 1965

attitude to adopt? Very simple: make the assumption, first, that the old style — whatever it is — has exhausted its possibilities and can only offer repetition or trivial variations of the familiar masterpieces. I do not suggest that you should be convinced that your favourite music is obsolete. I invite you to assume that it may be: for by trying to think that it is, as the new composer has obviously done, you will begin to discover what he is up to."

The principal obstacle to the progress of electronic music at the present time is that most major commercial concert halls are inadequately equipped to present the considerable repertory of electronic music that already exists, much of it on four-track tapes. For example, the majority of these halls have either inferior tape recorders or no tape recorders at all.

The young, knowledgeable audiences that are willing to travel to out-of-the-way locations to hear the latest electronic-music creations are, of course, smaller and less influential than audiences at conventional concerts, but electronic composers are confident their day will come.

Proof of the advance of electronic music is everywhere to be seen. One prominent instance, of course, is the existence of the Columbia - Princeton Electronic Music Centre itself, established in 1959 with the aid of a 200,000-dollar grant from the Rockefeller Foundation. Its three studios operate round the clock at full capacity, turning out new music, performing and recording it, accomplishing some very important and exciting experiments in the electronic medium, and bringing new laurels to the Ivy League for its role in educating the young.

One of these studios houses the 250,000-dollar RCA Electronic Music Synthesizer, which was developed primarily as a research tool, but is now one of the most vital pieces of equipment in the whole sphere of electronic music.

The Columbia-Princeton Centre, with its many panels of futuristic electronic equipment, has a strong resemblance to the space-age control centres at Cape Kennedy, Florida. It is located in a gloomy, white, four-storey converted milk plant by the Hudson River on West 125th Street in Manhattan, which the Centre shares with the Columbia University Chemical Engineering Research Laboratories.

The directors of the Electronic Music Centre are Ussachevsky and Luening, representing Columbia, and Babbitt and Roger Sessions, representing Princeton.

The Rockefeller grant has expired, and the Centre's operations are now financed by both universities. Guest composers, fellowship and enrolled students at both schools, and some faculty members use the Centre. But its capacities are not unlimited. As Babbitt says: "Three composers are now using the Synthesizer, and that's too many."

The existence of the Columbia-Princeton Centre is only one proof of the progress of electronic music. Abroad, there are electronic-music studios in such diverse locations as Cologne, Tokyo and Milan. There is a definite audience for electronic music on records.

The Phillips Petroleum Company commissioned Varese to write his "Poeme Electronique" for performance over 400

loudspeakers inside the company's Le Corbusier-designed pavilion at the Brussels World's Fair in 1958. Ussachevsky wrote what was probably the first all-electronic music score for the Sartre film "No Exit." The New York City Ballet presented a ballet entitled "Electronics" with choreography by George Balanchine and an electronic score by Remi Gassmann.

The New York Philharmonic's pre-

things about music's fundamentals is the 'why' of electronic music. We now have complete freedom of rhythmic opportunity, and new, previously non-existent timbres. Certainly, these are advantages that should be of interest to any composer. As the novelty wears off, and it is beginning to, we are going to have more and more responsibility to produce better and better music that will endure."

Divergent styles and attitudes are

Taken in 1955, this now historic picture shows Mr Herbert Belar (foreground) and Dr Harry F. Olson at the controls of RCA's Electronic Music Synthesizer. This equipment was used to produce the early RCA LP disc of synthesized sound, including several solo and group instrumental items and an example of synthesized human voice.



cedent-shattering and controversial avant-garde festival in 1964 included electronic music, though hardly at its best. The Music Critics' Circle of New York in 1964 cited electronic compositions for the first time in its history. And dancer-choreographer Alwin Nikolais even borrows Ussachevsky's studio to compose electronic scores for his avant-garde dance events at the Henry Street Playhouse in Manhattan.

Many composers and critics believe electronic music has established itself as part of the cultural community and is definitely here to stay. This does not mean that its advocates are pressing for a musical coup d'etat.

"We're not interested in supplanting anything or anybody," says Babbitt. "We're interested in supplementing what already exists."

Says Ussachevsky: "Like any other composer, the composer of electronic music is still faced with the eternal problem of finding that magic ratio between colour, duration, and rhythm that makes a given piece of music great. But the opportunity to find out new

represented at the Columbia-Princeton Centre. Babbitt, the most prominent figure to use the RCA Synthesizer and one of the composers cited last year by the Music Critics' Circle, is a pitch composer and organises his compositions around the 12-tone principle (pioneered by Arnold Schoenberg) he formerly employed as an instrumental composer.

Others, like Ussachevsky, put stress on colour and timbre. In addition to using electronically produced sounds, they work with tape recordings of real (or concrete) sounds that can be manipulated. These are primary interests and do not mean that Babbitt is not concerned with colour or Ussachevsky with pitch.

Babbitt once taught mathematics, but he is understandably annoyed at any suggestion that his music is mathematical or that he composes by formula. Actually, he composes by ear. With the RCA Synthesizer, he can test a composition as he goes along, and if he does not like what he hears he can erase it. This offers obvious advantages. One disadvantage, however, is that the

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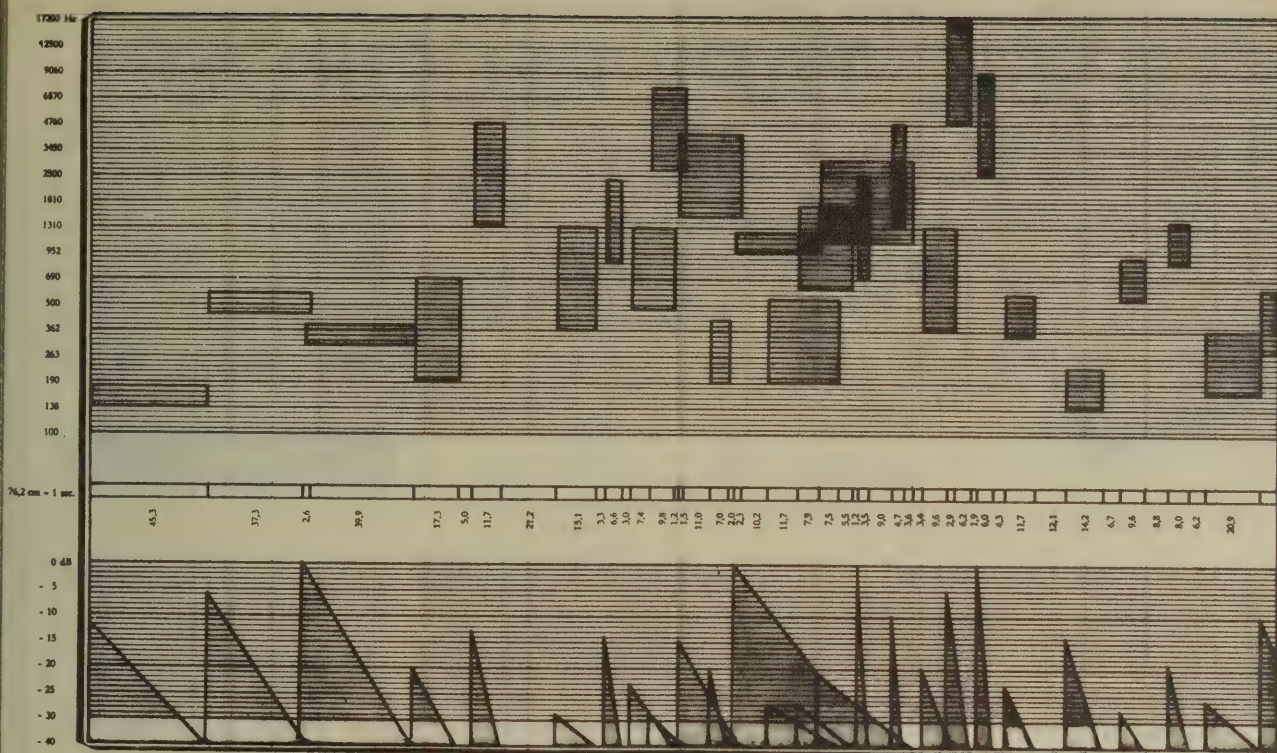


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Reproduced here is a page from the score of Karlheinz Stockhausen's "Electronic Study Two." The heavy concentration of horizontal lines at the top half of the score represents pitch, or frequencies per second. The pitch range is 100 to 17,200 cycles, the lowest represented by the bottom parallel line at the middle of the score and the highest by the top line. The shaded portions indicate overlapping note mixtures. The horizontal lines at the bottom represent the volume, or decibel range. The highest parallel line is the loudest, and the lowest line the softest. It should

be noted that the shapes in the volume group correspond horizontally to the shapes in the pitch group. The descending lines leading away from the jagged points show that the volume of the sound is decreased almost as soon as it is produced. Between the pitch and volume groups are two parallel lines representing duration of the musical notes. These durations, indicated in centimetres, also correspond horizontally to the shapes of the pitch and volume groups. Universal Edition, Ltd., published the score in 1956.

Synthesizer is not transistorised and its valves take time to warm up.

"But it is a remarkable machine, and we know it can do anything in the world," says Babbitt. "The only limitation upon it is our knowledge of the analytical components of sound. You tell me what the components of a violin passage are, and I will reproduce it with the Synthesizer. But no one has yet analysed violin sound to that degree.

"We've discovered that we know very little about how we hear. And in our efforts to get back to the fundamentals of sound, we are asking ourselves important questions. What are the limits of audibility? Can the ear be trained beyond certain thresholds?

"We know for certain that we can play passages too fast for the ear to hear, and we know that we can fool the ear about such matters as duration. We also know that the ear can hear certain trills with absolute clarity, and yet these trills are so fast that they cannot be duplicated by the best singers or instrumentalists.

"We've discovered that there is a vast difference in sound characteristics between the opening fraction of a second of any sound — known as the attack characteristic — and what follows.

"Ussachevsky and I once heard a violin sound that had been shorn of its attack, and we mistook it for an oboe. But the attack characteristic is only one of an array of sound behaviour patterns that determine what we hear—like the factor we call the sound's envelope, that is, the sound's rise and fall characteristic, or the shape of the sound's volume as the sound comes on. The envelope can

actually determine timbre. Knowledge like this is profoundly important to us."

All of this obviously makes musical composition a complicated business. Some composers, such as Stockhausen, use graph paper to record their works of art. And a disciple of his is said to have spent close to a year writing down "Kontakte"—after Stockhausen had composed it on tape.

In the United States, the Patent Office demands that all music must be submitted on regular music paper with regular musical notation. This is difficult for electronic composers to do, because the new electronic scores have left conventional notation far behind.

For example, the score for "Stereo Electronic Music No. 1," by Bulent Arel, of Istanbul, Turkey, has five separate sets of instructions: 1. "The pitch element," 2. "The noise element," 3. "Duration independent of reverberation or feedback," 4. "Amplitude wave," and 5. "Time in seconds." They are written down on conventional music paper all right, but obviously because of tradition only.

What it all means from the composer's point of view is that rich, new natural resources of sound await him, and that complex and exciting ways of using them are at his fingertips. From the other side of the footlights, it means that the listener is going to have to do some hard listening and allow himself to be exposed to the new music.

This is not a new phenomenon; for generations, audiences have had to get used to new composers, many of whom ultimately became world famous. In

return for all this, the listener will be entitled to enjoy the good music and reject the mediocre when it is performed. In any age, the only enduring characteristic is genius.

Is there any validity in the fear that the individual is going to wake up one morning and find that he no longer counts for anything, that automation has taken over? On this subject, Dean Barzun says:

"Most people of artistic tastes share the widespread distrust and dislike of machinery and argue that anything pretending to be art cannot come out of a machine: art is the human product par excellence, and electronic music, born of intricate circuits and the oscillations of particles generated by Con Edison, is a contradiction in terms.

"Here again the answer is simple: the moment man ceased to make music with his voice alone, the art became machine-ridden. Orpheus' lyre was a machine, a symphony orchestra is a regular factory for making artificial sounds, and a piano is the most appalling contrivance of levers and wires this side of the steam engine."

How did it come about, this revolution in musical composition? Well, electronic or mechanical equipment is really nothing new in music. The musical history books are full of mechanical or electronic gadgets of unbelievable variety, ingenuity, and, often, impracticability.

One of the most intriguing of these was the Theremin, named after the Russian scientist, Leon Theremin, who invented it in the mid-1920s. It consisted primarily of two oscillators and a loud-

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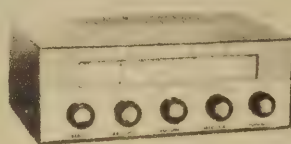


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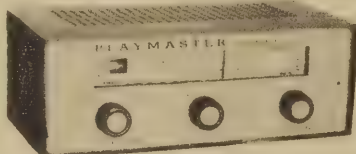
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speaker and was played by moving the hands back and forth near a vertical rod antenna on the right and a horizontal loop antenna on the left. The movements of the right hand determined pitch, and the left hand governed loudness. For a time, the Theremin was manufactured by RCA. The instrument's essential drawback was that it could not go from one pitch to another without an intervening glissando.

Musical Rube Goldbergs popped up everywhere. There were even colour organs with which performers seated at keyboards could project colour patterns on screens to accompany chosen pieces of music. The clavilux, invented about the same time as the Theremin, made possible colour recitals without music.

But the most important precursor of electronic music was musique concrete, a Parisian flowering of the late 1940s during which composers first began to combine in aural montages real sounds such as those produced by machines, instruments, and voices. And near the end of that decade came the introduction of magnetic tape recording machines, a development that helped to insure the future of electronic music.

In the early 1950s at Columbia University, Ussachevsky and Luening began to experiment with recorded sound and tape recorders, and an electronic studio was established. Meanwhile, exciting things were taking place at the Acoustical and Electromechanical Research Laboratory of the RCA Laboratories at Princeton, N.J., under the guidance of Dr Harry F. Olson, Director, and Herbert Belar, Fellow. Complex and exhaustive studies were being made of the characteristics of musical instruments to provide improved means for the reproduction of sound.

One thing learned from these studies was that the horizons of sound were a lot broader than the area embraced by the familiar strings, woodwinds, brass, and percussion instruments. As a result, Olson and Belar decided to develop a system for the production of music without limitations. The RCA Electronic Music Synthesizer was the result.

Initial experiments with the Synthesizer included analysing recorded selections by famous artists and then reproducing them with startling likeness. Some of

HOAX AND A MORAL

A GUST of amusement rippled through the music world some years ago as a result of the premiere on the BBC Third Program of a twelve-minute composition called "Mobile for Tape and Percussion," announced as being by Piotr Zak, "one of the most controversial figures in contemporary music." The broadcast was duly covered in the "London Musical Press," and one critic remarked of the Zak premiere that "it was certainly difficult to grasp more than the music's broad outlines..." Another wrote primly that "a succession of whistles, rattles and punctured sighs proclaimed all too shamelessly their non-musical origins."

The merriment began two months later, when the BBC revealed that there was no Piotr Zak and that his "composition" was simply a haphazard tape-recorded montage of the sounds made by various percussion instruments played at random. As one BBC music division employee described the creative process, "We dragged together all the instruments we could find and went around the studio banging them."

This amiable deception recalls to mind similar instances of leg-pulling in the art world, where daubings done by chimpanzees and psychotic children have been exhibited and soberly discussed as being the latest and most provocative paintings by artists belonging to the new schools of abstract expressionism.

Musical hoaxes, somewhat of this kind, have a long and not entirely dishonorable history, going back at the very least to 1850. The motives behind particular instances of leg-pulling have been diverse. The BBC aimed to expose the pretensions of certain of the more far-out avant-garde composers and their hangers-on by demonstrating that some contemporary works are so recondite as to be indistinguishable from desultory thuds and poundings.

The BBC experiment made another important point, similar to the one made by the late Gerard Hoffnung in the hilarious Plunkt Contraplunkt item on his 1958 "Interplanetary Music Festival" recording: that harm can be done to the cause of contemporary music when there is confusion between finished art and hopefully artistic explorations.

The important masters of the early years of this century—Igor Stravinsky, Arnold Schoenberg, Bela Bartok, Alban Berg, Anton von Webern—seldom if ever presented for public performance works that were not finished to the very highest degree, from initial theoretical concept to final polishing. Regrettably, over the past decade too many "advanced" contemporary scores, in the electronic music field especially, have been presented as finished works when they were really very little more than laboratory experiments.

"It was a serious hoax to set people thinking," emphasised Miss Susan Bradshaw, who together with her fellow BBC colleague, Hans Keller, had pulled off the whole stunt. "That fake music can be indistinguishable from the genuine is a reflection on certain trends in present-day composition. We are sorry if we have embarrassed certain music critics." Would it not be more honest, and in the better interests of all concerned with the acceptance of new music, to bill tentative musical explorations as what they actually are rather than as works of major consequence ready to be accorded full critical evaluation? (From an article by David Hall in "HiFi/Stereo Review.")

these synthesised selections were heard in a demonstration record produced by Olson and Belar, "The Sounds and Music of the RCA Electronic Music Synthesizer," RCA Victor record LM-1922.

Several composers, including Babbitt

and Ussachevsky, heard about the RCA Electronic Music Synthesizer and went to Princeton for a look and listen and were enthusiastic. As a consequence, the RCA Laboratories were asked to build

(Continued on Page 158)

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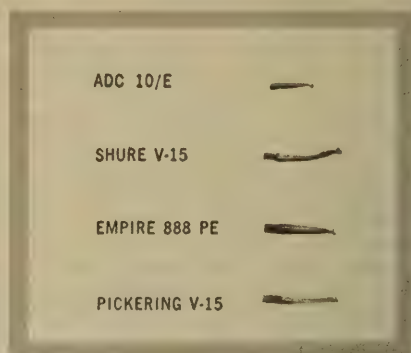
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Classical reviews

By RAMSAY PENNICUICK

La Boutique & L'Apprenti Sorcier

La Boutique Fantastique. Rossini-Respighi.
L'Apprenti Sorcier. Dukas.
Israel Philharmonic Orchestra. Conductor: Georg Solti.
Decca. Ace of Diamonds. Stereo SOOA 109. Mona DDA 109.

This is a delightful record. The first performance of *Boutique Fantastique* took place in London in 1919. Massine had done the story and choreography and Derain the superb set. It was an instantaneous success.

We have already spoken of the enormous number of small pieces which Rossini had written to amuse himself and into which Respighi and Britten had dipped. For this ballet Respighi dipped again but, for some reason, his arrangements of these various tunes don't sound vulgar in the way that they did in Rossini's. It may be that this vulgarity is not noticeable in a stage work dealing largely with dolls and comic characters. Anyway his scoring of the various tunes is done with the greatest skill and the cover note is so clear that anyone could follow the story without ever having seen the ballet. The performance is excellent in all respects.

The cover note suggests that the reputation of Dukas rests entirely on one

work, the famous *Sorcerer's Apprentice*. This is not altogether correct. Dukas has an opera, *Ariane et Barbe Bleue*, which is based on the same story as Bartok's *Bluebeard's Castle*. This opera is performed with the greatest success in Paris. The music is enchanting, though the action is inclined to be static.

The story of the *Sorcerer's Apprentice* is well known to music lovers—how he dabbled in spells, caused a broom to start drawing water from a neighbouring well and then forgot the charm to stop the broom; so he chopped it in two, with the result that the two halves continued to bring the water until the place was flooded.

The eerie atmosphere is set at once and one quickly hears the theme of the broom on the clarinet. The showers of water are vividly suggested by the cascades of notes for the woodwind. When the broom has been cut in two, the double bassoon and the bass clarinet suggest the two halves in a most amusing manner. Once again, the program note is very clear and the whole work can be followed with ease.

Solti is a splendid and most musical conductor and the Israel orchestra is more than equal to all his demands. A record that can be highly recommended.

this concerto made by these artists and I presume it was made from the same matrix. While it is of great historic interest, it would be idle to pretend that the present recording is very satisfactory. The piano tone is poor, the orchestra is at times inaudible and there is no balance whatever.

Horowitz plays with great brilliance; in the first movement there is some wonderful octave playing. However, early in the second movement the syn-copated passages sound out of time owing to certain orchestral notes not being heard.

It must truthfully be admitted that there are several recordings of the work which are in every way superior to this.

★ ★ ★
SCHUBERT, Trout Quintet, op.114. Members of Fine Arts Quartet. Leonid Sorkin, violin; Irving Ilmre, viola; George Sorkin, 'cello with Frank Glazer, piano and Herold Siegel, double bass. World Record Club, TE/372.

The record cover contains an error. There are three movements on the first side, the third movement being a scherzo.

There is an explanation for the unusual collection of instruments in this work. The composer and his friend Vogl were on a walking tour of Upper Austria and they visited Steyr. There they found a flourishing musical community presided over by a wealthy man named Paumgartner who played the 'cello. This musical group was about to perform Hummel's Piano Quintet which is scored for this unusual group and Paumgartner commissioned Schubert to write a quintet for the same combination.

The resulting work was a great success and was acclaimed as the first of the composer's great chamber music works.

The quintet is full of lovely melodies and each movement possesses an atmosphere of happiness and poetic ideas. This is thought to be due to the lovely surroundings in which they had been walking.

Schubert cleverly saw that, with both the 'cello and bass playing in the bass clef, it would not do for the left hand of the pianist to add to this bass, so quite often the two hands of the pianist play in unison in the treble.

The performance is very good, the string quartet being well balanced and the pianist displaying all the requisite brilliance when necessary. The variations on the Trout song are particularly successful.

★ ★ ★
MUSIC IN OLD RESIDENCES. Potsdam: At the Court of Frederick the Great. **FREDERICK THE GREAT (1712-1726):** Symphony in D major for flutes, oboes, horns, strings and continuo. Karl-Heinz Zoller and Fritz Demmler (flutes). Wolfgang Meyer (harpsichord). **CARL HEINRICH GRAUN:** Aria from Opera, *Montezuma*. Pilar Lorengar (Soprano). **JOHAN JOACHIM QUANTZ:** Concerto in F minor for flutes, strings and continuo. Karl-Heinz Zoller (flute). Wolfgang Meyer (harpsichord). **C.P.E. BACH:** Concerto for harpsichord and strings. Werner Smigelski (harpsichord). Berlin Philharmonic Orchestra. Conductor: Hans von Benda. Record Society Edition No. 6163. (Available in Mono and Stereo).

Frederick the Great had a great

Beethoven — Emperor Concerto

BEETHOVEN, Emperor Concerto. Artur Schnabel, Boston Symphony Orchestra. Conductor; Erich Leinsdorf. RCA Stereo LSC-2733. Available also in mono.

In this work Beethoven establishes a perfect balance between the soloist and the orchestra, makes the cadenzas part of the work and experiments in orchestral sonorities in which the piano is continually made to participate. In many ways it is more of a symphony concertante, with the piano an integral part of the work. He seemed to feel that he had done his utmost with this form and wrote no more piano concertos.

The work begins with three cadential chords for the orchestra; then follows the first cadenza which leads directly into the main subject. There is an amusing touch in the second subject in the recapitulation when the theme is given to the second horn. The story is that the composer gravely distrusted the ability of the gentleman playing first horn. The bridge from the second movement leading into the finale is of striking originality.

The pianist at the first performance of the concerto in Leipzig was Friedrich Schneider. The work was hailed as one of the most imaginative, brilliant and difficult concertos in existence. Rubinstein is a truly marvellous pianist. On his visit to Australia last year he showed that his abilities were not in the

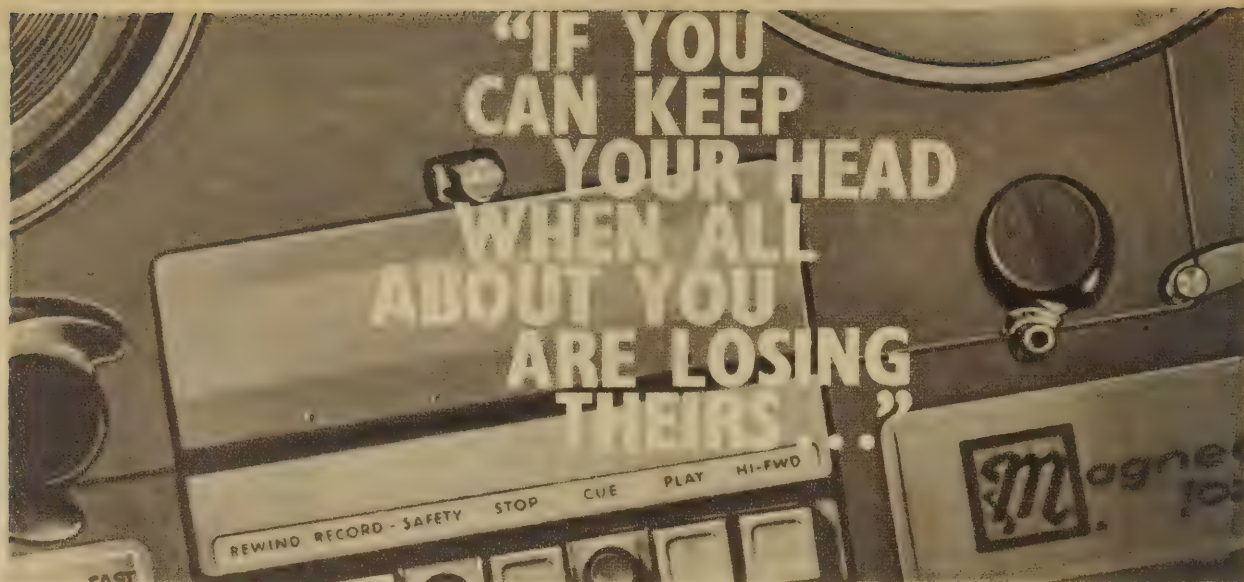
least impaired by age. His technique is as perfect as ever but he seems to have developed even greater sensitivity and his speeds are always completely reasonable.

From the opening bars of the concerto he takes complete command of the situation. His playing of the main theme of the second movement, in B Major could not be more poetic and he knows exactly how much rubato to use without upsetting the classic atmosphere. The final Rondo is full of life and vitality. The splendid Boston Symphony Orchestra play excellently and I prefer Leinsdorf when he is accompanying a soloist.

★ ★ ★
TSCHAIKOWSKY, Piano Concerto No. 1. Vladimir Horowitz, pianist, Arturo Toscanini and the N.B.C. Orchestra. RAC Mono LM-2319.

The sleeve of this record relates that on the afternoon of April 25, 1943, a charity concert was given in Carnegie Hall, New York, admission to which was only to be had by the purchase of War Bonds. The program was composed of works of Tschaiowsky and, in addition, the manuscript of Toscanini's orchestration of the Star Spangled Banner was auctioned. The result was that eleven million dollars were raised.

A recording of the piano concerto was taken and this is it transferred to L.P. Some years ago I had a recording of



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aversion to Potsdam and, for the first five years of his reign, he refused to establish his court there. However, in 1745, he commenced to build a summer palace, Sans Souci, well outside the town. The palace itself was designed by the king but the most important features were the library and the music-room. The whole palace was beautifully furnished but the king's greatest interest was music, both as a flautist and a composer. Quantz taught him the flute and Graun composition. The Symphony in D major is written in the popular fast-slow-fast form but the music is well contrasted. As a flautist he was particularly concerned with the melodic line and the slow movement displays virtuoso writing for the two flutes. The work reflects the exquisite taste of the room in which it was performed.

Carl Heinrich Graun was born in 1704 and studied voice and composition. He soon won great fame and came under the favour of the king. His opera Montezuma was very popular and the aria for soprano shows a sensitive composer with surprising expressive ability. Pilar Lorengar has a lovely voice but in the recording it seems to have a metal edge which is not so in her other recordings.

Johan Joachim Quantz was born in 1697 and was the son of a blacksmith. He showed outstanding talent as a child and an uncle offered to pay for his education as a musician. He soon became an outstanding flautist. When the king heard him he at once decided to learn the flute. Quantz was engaged as his teacher and also as a composer of works for him to play. His concerto in E minor shows a happy blending of the French and Italian styles with the German idiom. The recording is highlighted by the brilliant and persuasive playing of the soloist Zoller.

C. P. E. Bach was the second son of J. S. Bach at Leipzig, and in 1740 he was appointed harpsichordist at Frederick's court. His thirty years spent there were very unhappy as his ideas were very advanced and progressive and the conservative king liked to perform the same 300 concert which were done in rotation. However, in 1767, the death of his famous godfather, Telemann, enabled him to apply for the part of musical director in Hambourg and he was appointed the same year. Tremendous originality is the keynote of Bach's music and Burney discovered that his characteristics were not founded on his famous father. The harpsichord concerto is a powerful and passionate work, amazingly vital and dramatic for the period. It is splendidly played by Werner Smigelski. This is a most interesting record. The music is very varied and the playing of the Berlin Philharmonic under Von Benda is always excellent.

★ ★ ★
CHOPIN, Les Sylphides, SCHUMANN, Carnaval. Philharmonic Orchestra conducted by Robert Irving. World Record Club, T/4007.

There seems to be no end to the demand for records of the music of popular ballets and the present one is one of the best that has appeared.

The story is well known of how Fokine devised the first ballet for a charity performance, under the name of Chopiniana as the music consisted of various works of Chopin orchestrated by Glazounow. It enjoyed considerable success and in the following year, 1909, it was revised and presented as Les Sylphides at the first legendary season of

the Ballet Russes. Since then it has become the most popular ballet in existence and is in the repertoire of practically every theatrical ballet company.

The present arrangement of the music is by Douglas and it must be admitted that it is much superior to the arrangements we hear in Australia. As far as the playing is concerned, local ballet fans would hardly recognise the music after the terrible performances of "scratch" orchestras which are the general rule here. Robert Irving is a most musical conductor and every section of the Philharmonia Orchestra is sensitive and flexible.

Schumann's Carnaval is one of his best known works and consists of an assortment of piano pieces which he collected under the name Carnaval. Each piece has a name of its own and often there is some connection as various pieces represent different sides of his own nature, that of his wife and of his friends. The various pieces are orchestrated by well known Russian composers as far as No. 11, Chiarina. From 12 to 20 the orchestrators are not known. However I think I have heard the entire work orchestrated by one person. Coquette, orchestrated by Rimsky-Korsakov, and Papillons, orchestrated by Tcherenpin, are particularly effective but they are all well done and the playing is just as good as in Les Sylphides. The record is strongly recommended to all ballet lovers.

★ ★ ★
MICHEL RICHARD DE LALANDE (1675-1736). Symphonies for the Suppers of the King. Concert of Trumpets. Third Caprice. Second Fantasy. First Caprice. Jean Francois Paillard Chamber Orchestra. Conductor: J. E. Paillard. World Record Club, TE/371.

Lalande was the fifteenth child of a tailor and was originally a chorister. He showed great musical gifts and taught himself to play the violin, bass viol, organ and harpsichord. When his voice broke at the age of 15 he applied himself to the organ and made such progress that he was soon appointed organist in four different churches in Paris. He rose steadily through a number of different offices and, in 1704, was in complete control of the Royal Chapel and director of chamber music, serving as a composer in both capacities. Lalande's greatest fame rests on a series of motets written for the chapel of Versailles. Although he was definitely a contrapuntal composer he adapted his style most successfully to the more homophonic methods of the admired Italian style.

The first of the festivals given on the lakes at Versailles date back to 1674. Louis XIV was extremely fond of this form of entertainment with the illuminated barges lighting up the glistening waters. The concert for trumpets is scored entirely for woodwind and a favourite trick was for a phrase for the trumpets to be echoed by the wind instruments.

The third caprice is scored for strings, oboes and flutes and makes much use for solo instruments. The second fantasy is thought to be the oldest of these works. It is scored for 2 oboes, bassoon, strings and continuo and has not suffered from the heavy ornamentation added throughout the years.

The first caprice begins with a stately overture followed by a number of expressive sections. Some people con-

sider that the trumpets and kettle drums were a late edition to the woodwind and strings.

The chamber orchestra plays with great charm and Paillard is a most successful conductor. However, one would be well advised not to play all the disc at one sitting. As well recorded as it is, it can become monotonous.

★ ★ ★
SCHUBERT, Trio No. 1 in B Flat, Op. 99. Isaac Stern, violin, Leonard Rose, cello, Eugene Istomin, piano. C.B.S. Masterworks. Stereo SBR 235113.

This trio has been recorded many times, being famous many years ago in the recording made by Cortot, Thibaud and Casals.

The work is essentially Schubertian, particular features being the melodies, piquant rhythms, romantic melancholy and harmonic variety. The first movement is a model of the composer's formal practices. This movement opens in a most invigorating manner and it lives up to the promise of the opening theme. The development is a particularly happy example of the composer's skill in giving symphonic stature to a lyrical theme. The slow movement has a melody which can't put forward claims as one of the loveliest the composer ever wrote.

The performance is an excellent one. Stern has long been recognised as one of the best violinists in the world and particularly interested in chamber music. Rose is a most accomplished and cultured cellist. When Istomin was in Australia he had a good technique but his musical gifts were not very striking. However, some time ago I read that he

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had been playing in chamber music with the veteran Casals. He has certainly developed into an excellent chamber music player and the piano part of the trio is excellent, brilliant and sensitive in turn. The recording could not be better.

★ ★ ★

MAHLER. Kindertotenlieder. Four songs to words by Ruckert, Dietrich Fischer-Dieskau. Berlin Philharmonic Orchestra. Conductor: Karl Bohm D.G.G., 138879 SLPM. Stereo.

Mahler seemed to be in complete sympathy with the poems of Ruckert, whose words he used in both these song cycles. In the Kindertotenlieder, one of the composer's earlier works, he showed himself in sympathy with the personal tragedy of the poet's life and his simple romantic lyricism.

In the second four songs, which are among the last works the composer wrote, the poems deal with withdrawal from the world and nowhere is Mahler's musical language and his scoring more personal.

The scoring throughout the two cycles is completely original. Most unusual groups of instruments are used and certain obligato instruments lend wonderful colour to the voice as, for instance the cor anglais in Wenn dein Mutterlein, the third song in the first cycle.

The four Ruckert songs are even more wonderful than the first cycle. In the first one, Um Mitternacht, no strings are used at all but an oboe d'amore gives unique colour to the work. The song ends with a wonderful affirmation of dependence on God. The second one, Ich Atmet Einer Linden Duft, is a love poem. In the last one, the cor anglais is again used with wonderful effect.

Fischer-Dieskau is surely the greatest living singer as well as being a superb musician. All the songs are so beautifully sung that it would be idle to choose any particular one. His voice has never been more perfectly controlled and Karl Bohm and the Berlin Philharmonic accompany most sensitively. Altogether a superb record.

★ ★ ★

BUSONI, LISZT. John Ogden (pianist). BUSONI. Sonatina No. 6. No. 4 of Elegies. Nine variations on a Chopin Prelude.

LISZT. Dante Sonata, Mephisto Waltz No. 1. World Record Club T/4012.

We have already spoken of Busoni's great gifts as a pianist and as an editor. We have also mentioned the fact that he seemed to be unable to write a tune. This sonatina No. 6 is based on various tunes from Carmen and, as far as I can see, has neither shape nor form. It only

succeeds in making the splendid tunes sound cheap and silly.

The excerpt from the Elegies is taken from some incidental music the composer wrote for Gozzi's play Turandot. Professor Dent explains the unexpected introduction of Greensleeves as being included in a book of old lute music and the composer inserted it in the work in the belief that it was a Chinese tune. This is surely rather a criticism of his musical knowledge.

I can see no point in the variations on the Chopin Prelude whatever.

The Dante Sonata is taken from the Years of Pilgrimage and is an ungainly work which represents the composer's reactions to the reading of Dante.

The Mephisto Waltz was also orchestrated by Liszt and both these works display the composer at his weakest.

John Ogden is a young English pianist who studied with Petrie, Busoni's most famous pupil and also an exponent of Liszt. This probably explains Ogden's fondness for these two composers. Ogden is a splendid pianist, excelling in works of brilliance and virtuosity. It is a pity to hear him wasting his great gifts on such worthless music. The Busoni Sonatina was written as late as 1920 and one wonders what the reaction would have been if an unknown composer of the period had produced such a work. ■

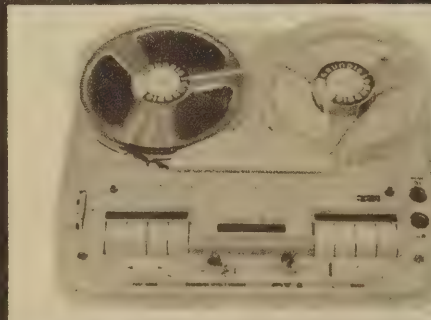
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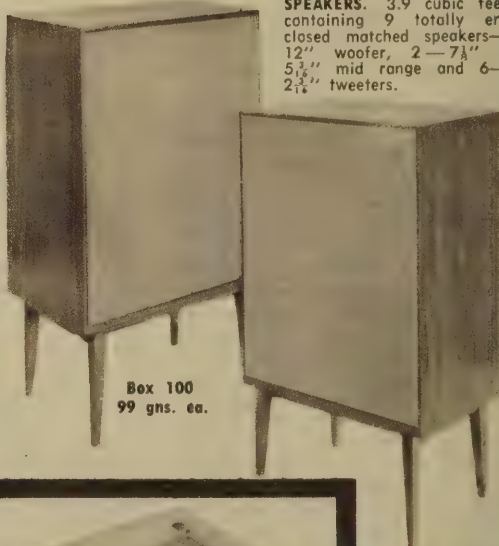
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DOCUMENTARY RECORDS

Reviewed by Ellis Blain

EDGAR ALLAN POE, "TALES OF TERROR," read by Nelson Olmsted, Vanguard VRS 9007 (mono).

H. P. Lovecraft, in his "Supernatural Horror in Literature," describes the impact of Poe's writing thus: "A witches' sabbath of horror flinging off decorous robes is flashed before us—a sight the more monstrous because of the scientific skill with which every particular is marshalled and brought into an easy apparent relation to the known gruesomeness of material life." It would be hard to find a more concise or penetrating analysis.

Three of the tales presented here have been recorded previously by Basil Rathbone and, while I must admit to preferring Rathbone to Olmsted as a storyteller, the three new pieces, "The Fall Of The House Of Usher," "The Tell-tale Heart" and "The Masque Of The Red Death," will make this new disc well worthwhile to the many who enjoy this kind of "exquisite perversion."

Olmsted is an actor and writer of wide experience in the field of radio in America and his performance here is powerful and entirely in keeping with the author's extraordinary ability to raise disease, perversity and decay to the level of artistically expressible themes.

Recording is adequate.

★ ★ ★

"A FOX'S DAY," adapted from "Reynard The Fox" and read by JOHN MASEFIELD.

Masefield is one of our most underestimated writers, much as Elgar has been one of our least appreciated composers. But Sir John, who was born in 1878, has a unique talent and when this talent for the creation of a narrative poem is combined with his own reading of it, he assumes, inevitably, his full stature.

The story is of hunting and the hunt and let it be said at once that it will stir up the passions of those who are opposed to blood sports, despite the emphasis put upon the cruelty of the beast itself in its heyday. But this is no sermon. The story is slanted neither this way nor that; it is a tale for its own sake and a splendid one at that.

However, the truly remarkable aspect of the record is the extraordinary power in the telling of the story. It is inconceivable that the reader is a man in his eighties. Only in the brief introduction does he sound laboured or tired; once the story begins he is part of it and we become part of it from the outset and remain enthralled until the end. Truly, this is a case where the author brings to the performance of his work "a personal touch, a special quality that no other reader could have achieved."

★ ★ ★

"THE ENGLISH POETS FROM CHAUCER TO YEATES—John Donne. THE LOVE POEMS." Argo RG403 (mono).

The love poems of John Donne are unique and they are among the finest erotic literature in the English language.

Although he lived four hundred years ago, Donne's writing presents no more difficulty to a reader of today than does

Shakespeare's. In fact, the imagery of most of his poetry is even more contemporary in its directness, even earthiness.

These readings, by a cast of three, are as authentic and as moving as any so far heard in this superlative series. The readers are all leading English actors, specialising in this era, Richard Johnson, Peter Orr and William Squire. The unmistakable authority, taste and enthusiasm of George Ryland's direction is everywhere apparent. In fact, I would find it hard to believe that anyone with even a basic compatibility with poetry, having heard one record of this series, could be content until at least a representative selection of the sixty-odd discs has been acquired.

John Donne's love poems are among those most likely to appeal at first hearing, although, like all writing in an earlier idiom, they reward profoundly the study of repeated listening.

An excellent text is included and recorded sound is first rate.

"You know the story of the dying Scotsman who asked for a tune on the bag pipes. When the doctor visited the ward next morning he found the Scotsman fully recovered, but all the other patients had died."

—Hugh MacPhee on the B.B.C.

THE ENGLISH POETS FROM CHAUCER TO YEATES—THE METAPHYSICAL POETS. Argo RG 404.

The Poets represented here are Donne, Francis Quarles, Thomas Traherne, George Herbert and Henry Vaughan. Of these, Donne and Vaughan are the best known and the most important.

Donne's love poems as contained on the record reviewed above are all the more remarkable when listened to in context with his later religious poetry. The love poems rivet the attention with their frankness, their beautiful language and convincing sincerity.

But the "Holy Sonnets" which are Donne's contribution to this recorded selection are altogether more profound material which, after all, is only to be expected since, by the time they were written, his style had developed its utmost refinement. The change of heart and mind that made way for these metaphysical creations is nicely expressed by Izaak Walton in his "Life Of Donne."

"It is a truth that in his penitential years, viewing some of those pieces that had been loosely—God knows, too loosely—scattered in his youth, he wished they had been abortive, or so short-lived that his own eyes had witnessed their funerals; but, though he was no friend to them, he was not so fallen out with heavenly poetry as to forsake them in his declining age, witnessed them by divine sonnets and other high, holy and harmonious composites."

The remaining poems are of lesser standing but much more than make-weights. Another fine record in this series but of less general interest than its companion.

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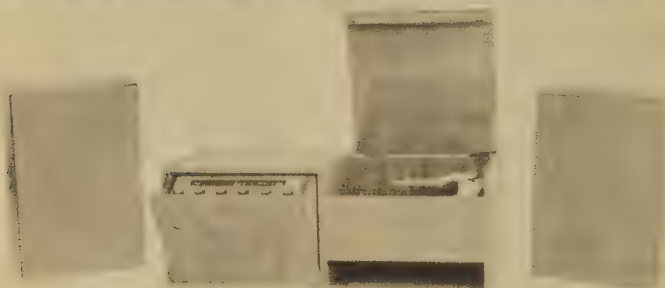
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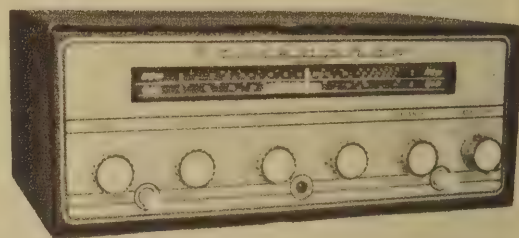
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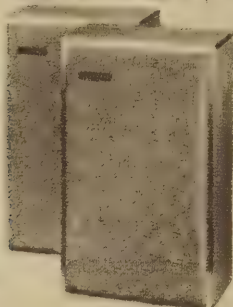
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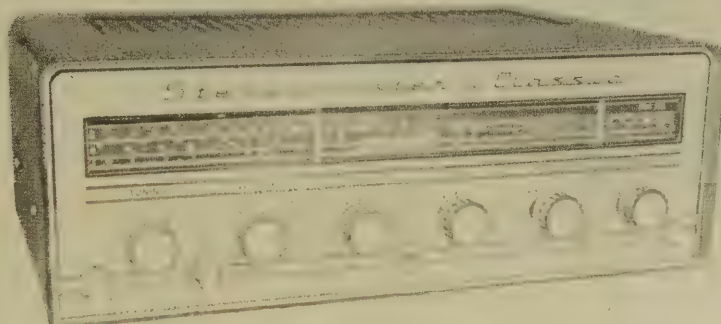
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VARIETY FARE

"Electronics Australia"

Staff Review

Panel

Devotional

BILLY GRAHAM'S FAVOURITES.

George Beverly Shea, soloist, with Tedd Smith piano and Don Hustad at the organ. Stereo, R.C.A. Dynagroove LSP-3346. (Also available in mono).

Interest: More Bev. Shea solos.

Performance: Completely characteristic.

Quality: Good.

Stereo: Unimportant.

Having at one time or another, reviewed most of Bev. Shea's albums, there is nothing new I can say about this most popular of all Gospel singers, who seems no less enduring, nor less devoted, than Billy Graham himself.

This group of Gospel songs, so the jacket relates, was nominated by Billy Graham, as the favourites stemming from more than 20 years of association with Bev. Shea in gospel campaigns:

"The Touch Of His Hand On Mine," "The Lord's My Shepherd," "Standing On The Promises," "He Giveth More Grace," "I've Tried In Vain," "The Cross

Is Not Greater," "And Can It Be," "Follow, I Will Follow Thee," "The King Of All Kings," "But This One Thing I Know," "When I Get To The End Of The Way," "To God Be The Glory."

If you're one of Bev. Shea's many admirers, you can hardly fail to enjoy this latest album. (W.N.W.).

★ ★ ★

SING WITH THE LAYMEN SINGERS.

Directed by Ben Allen and produced by Paul Mickleson, with Charles Magnuson piano and Don Fontana organ. Stereo, Supreme, SS2016.

Interest: Male Gospel Choir.

Performance: Splendid.

Quality: Excellent.

Stereo: Excellent spread.

Here's another top quality devotional disc on the imported "Supreme" label.

The Laymen Singers is a group of businessmen, school teachers, artists and musicians — hence the term laymen — who have dedicated their talents to Gospel singing, with their own supporting pianist, organist and arranger.

They have their own weekly radio

program "The Laymen's Hour," broadcast throughout the U.S. and overseas.

Their performance on this album is smooth and polished and, while there is occasional instrumental support, including some organ bass that really shakes the floor, the emphasis is strongly on voice and blend.

The numbers, some spirited, some much quieter, add up to an excellent program: "He Keeps Me Singing," "I Will Sing The Wondrous Story," "In My Heart There Rings A Melody," "We Shall Walk Through The Valley Of Peace," "Do You Love My Lord," "Beyond The Sunset," "Stand Up For Jesus," "Brighten The Corner," "Open My Eyes That I May See," "I'm On The Battlefield For My Lord," "Spirit Of God Descend Upon My Heart," "The Lily Of The Valley," "Come Thou Fount," "Amazing Grace," "Wonderful Grace Of Jesus."

The record comes in a double fold jacket containing, as well, a music book with the arrangements of the numbers featured. This, in itself, should be valuable to pianists and organists.

Well sung and well recorded, it is one that I can heartily recommend for the family record collection. (W.N.W.).

★ ★ ★

KID'S BIBLE CLUB. Stories and Songs.

Mono only, Sword S-1408-L.P. (Distributed in Australia by Gospel Film Ministry Ltd.)

Interest: Bible stories and songs for children.

Performance: Appropriate.

Quality: Normal mono.

As the title implies, this is a record strictly for children.

Apart from "Uncle Earl," one of those ultra-benign characters one seldom meets in real life, and a Hammond organist who is certainly no beginner, the characters and the choir have a distinctive kindergarten sound. And this is where the disc should find its main use, or in

MUSIC OF FAITH AND INSPIRATION.

Stereo and mono, Reader's Digest three-record album. Various choirs, with soloists and orchestras.

Interest: Hymns, devotional songs.

Performance: Good.

Quality: Good.

Stereo: Normal spread.

With this new 3-record album, Reader's Digest provide for those who have a special interest in devotional music.

The records are primarily choral, but featuring the occasional soloist, and variously backed by piano, organ, brass ensemble and orchestra.

The music itself covers a very wide range from the traditional chant "Kol Nidre," through classically based items like the Bach-Gounod "Ave Maria" and the Addison-Haydn "Spacious Firmament" to congregational traditional hymns, well known in most denominations. Included also are a number of Negro spirituals presented by the Doris Akers "Sky Pilot Choir," and modern devotional songs like "You'll Never Walk Alone" (Carousell), "I Believe" and "May The Good Lord Bless and Keep You" from the television "Big Show."

Old and new are intermingled, so that each of the six sides is an individual program — and this is the best way to treat them. I doubt that many would want to sit through six sides of choral music in a row, even allowing for the fact that the various



choirs involved are excellent, as also are the soloists and orchestral groups.

The actual discs to which I listened were American pressings carrying the composite "Reader's Digest — R.C.A. Cyclophonic" imprint. The sound was clean, smooth and free from surface noise. Going on past performance, I have no reason to doubt that the local pressings, involving the Dynagroove facilities of R.C.A. Australia will be every bit as good.

"Music of Faith and Inspiration" is a well executed presentation intended for the "average" follower of devotional music, whose tastes stop short of the neo-classical cantatas or, at the other extreme, the hilly-billy religious "pops," which are so numerous, these days.

At the price of £5 per set of three records, boxed and with adequate background notes, it represents excellent value. Prospective purchasers of the companion album "Messiah" can effect further saving by buying the two together. (W.N.W.).

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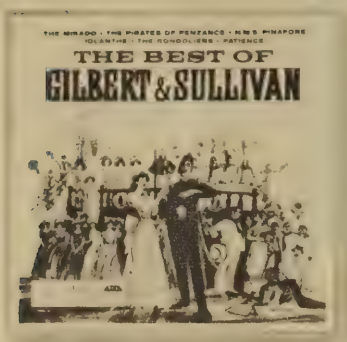
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We Sail the Ocean Blue • I'm Called Little Buttercup • The Nightingale • I am the Captain of the Pinafore • Over the Bright Blue Sea Sir Joseph's Barge Is Seen • I am the Monarch of the Sea • Kind Captain, I've Important Information.

THE MIKADO

If You Want To Know Who We Are • A Wand'ring Minstrel, I • Behold the Lord High Executioner • I've Got A Little List • Three Little Maids from

School Are We.

THE PIRATES OF PENZANCE

Pour, Oh Pour the Pirate Sherry • Climbing Over Rocky Mountain • Oh, Is There Not One Maiden Breast • Poor Wand'ring One • A Policeman's Lot Is Not a Happy One.

IOLANTHE

Loudly Let the Trumpet Bray • When I Went To the Bar • When All Night Long • Oh, Foolish Fay • My Lord, a Suppliant at Your Feet.

THE GONDOLIERI

List and Learn • For the Merriest Fellows Are We • Thank You, Gallant Gondolieri • From The Sunny Spanish Shore • I Stole the Prince • Bridegroom and Bride • When a Merry Maiden Marries.

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a home where there are a number of small children.

There are sixteen tracks on the two sides. Each alternate track features a simple Bible story, five of them from Genesis, the other three from the New Testament: "Baby Jesus," "The Boy In The Temple" and "John The Baptist." The intervening tracks contain hymns appropriate to the stories.

An imported American pressing, the quality is to normal mono standards but, as I said, it's strictly for an audience of "kids" . . . little kids! (W.N.W.)

FROM STAGE AND SCREEN

IN HARM'S WAY. Original soundtrack of the Otto Preminger film. Music composed and conducted by Jerry Goldsmith. Produced by Neely Plumb. RCA 12-inch stereo, LSO-1100.
Interest: Movie music.
Performance: Original.
Recording: Excellent.

Stereo Quality: Inconspicuous.
The music from Otto Preminger's recent film, based on James Bassett's novel about Pearl Harbour, both for those who wish to re-live the film scenes and for those who have not as yet seen them: Background music for all sorts of dramatic action, Hollywood style; music to greet-one's-wife-on-the-wharf-by; music to gyrate-sensuously-by; music to greet-a-shipful-of-nurses-by; music to identify-a-body-in-the-morgue-by; music to-be-seduced-on-the-beach-at-midnight-by; music to be-drummed-out-of-the-regiment-by, and so on . . .

Frankly, it sounds rather boring by itself.
The tracks are called "Love Theme,"

THE BEST OF GILBERT AND SULLIVAN. The Royal Philharmonic Orchestra and the Beecham Choral Society conducted by James Walker. Stereo, Reader's Digest 3-record album. (Also available in mono).
Interest: G. and S. favourites.
Performance: Very good.
Quality: Wide, smooth, clean.
Stereo: At its best.

I started off one evening to merely "sample" this set and finished up listening to most of it at the one sitting — such is its appeal.

On the six sides are songs from six popular G. and S. operettas: "The Mikado," "The Pirates Of Penzance," "H.M.S. Pinafore," "Iolanthe," "The Gondoliers," and "Patience."

It would take far more space than is available here to list all the songs but there's well over fifty of them, including such favourites as "A Wand'ring Minstrel I," "I've Got A Little List," "I Am The Very Model Of A Modern Major-General," "I Am The Captain Of The Pinafore," "When I Was A Lad," "When I Went To The Bar," "Take A Pair Of Sparkling Eyes" and so on.

While many will know the words and music so well that they would want only to listen, others not so well acquainted with the operettas are well provided for.

On the box is a brief biography of

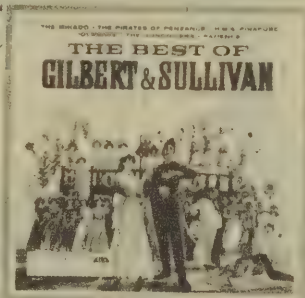
"Liz in Harm's Way," "The Rock," "Native Quarter," "Goodbye," "Positive Identification," "Battle Theme," "Night On The Beach," "Attack," "The Rock and His Lady," "Hawaiian Mood," "Change Of Command," "Medley from 'In Harm's Way': Try Again, Moonburn," "One-Way Ticket" and "First Victory." The recording is of excellent quality, with smoothly spread but inconspicuous stereo. (J.R.).

★ ★ ★
NOEL & GERTIE. Songs from "Private Lives," "Shadow Play" and "Red Peppers." Noel Coward and Gertrude Lawrence. Also songs by Noel Coward. H.M.V. Encore Series, 12-inch mono, OELP9130.
Interest: Vintage Coward, Lawrence.
Performance: Authentic.
Recording: Old but quite good.

Another of H.M.V.'s reissues of notable recordings of the past on their Encore label, this disc features Noel Coward and Gertrude Lawrence singing many of the songs they made famous. From "Private Lives" we hear "Love Scene;" from "Shadow Play," "Then," "Play, Orchestra Play" and "You Were There;" "Has Anybody Seen Our Ship;" from "Red Peppers," together with "I'll Follow My Secret Heart," "Zigeuner," "Mrs Worthington," "Half-Caste Woman," "Parisian Pierrot," "I'll See You Again" and the inimitable "Mad Dogs and Englishmen."

The recordings are old and restricted in range and frequency response, but otherwise quite good. (J.R.)

★ ★ ★
THE MANTOVANI SOUND. Big hits from Broadway and Hollywood. Mono, Decca LKA7597. (Also available in Stereo SKLA7597.)
Interest: Broadway, a la Mantovani.
Performance: Lush but precise.
Quality: Flawless.



Gilbert and Sullivan, while the individual jackets list the cast and outline the plots. A separate 8-page brochure contains the words of all the songs, which can be followed with ease — and in most cases with amusement!

Musically, the presentation is completely satisfying. The soloists and the choir are excellent, with diction outstanding, while the orchestra has all the weight and the definition necessary to keep the hi-fi fan well content. Indeed, a word of commendation should go to RCA for the technology back of the pressings.

At £5 for the set, and with a further reduction to those who couple it with a purchase of "Joyous Music For Christmas Time," it is value indeed. (W.N.W.)

643

Here is a new turntable made by S.R.T. (Scandinavian Radio and T.V. Co. of Denmark). It is a marvellous looking job especially when mounted on its imported palisander wood base and with its smoky plastic cover—and it has the following advantages.

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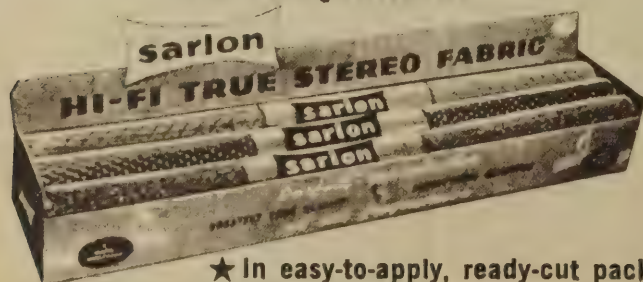
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This album, so the jacket notes point out, comes as a climax to nearly 20 years of music making by Mantovani—20 years during which he has developed and exploited the lush sound of his "singing strings" orchestra. It began, we are reminded, with a presentation of "Charmaine," which achieved enormous popularity in the Mantovani style — a style to which it lent itself so admirably.

Well, Mantovani does it all once again, as commendably and enjoyably as ever,

with these hits from the new generation of musicals:

"Dear Heart," "People," "Charade," "Fiddler On The Roof," "Who Can I Turn To," "Hello Dolly," "What Kind Of A Fool Am I," "As Long As He Needs Me," "I Have Dreamed," "The Sweetest Sounds," "I've Grown Accustomed To Her Face," "Climb Every Mountain."

Recommended, if you're at all partial to Mantovani. (W.N.W.)

Instrumental, Vocal & Humour

VIVE LA FRANCE. Roger Wagner Chorale. Vocal arrangements by Roger Wagner; orchestral arrangements by Greig McRitchie. Stereo, World Record Club S-7099. (Also available in mono).

Interest: French songs.

Performance: Smooth.

Quality: Very clean.

Stereo: Nicely spread.

This disc no sooner reached my home than it was commandeered by one of the younger members of the family who happens to be studying French — and, of course, French songs.

The Chorale has not made any conscious effort to emphasise diction but, along with the printed words in the jacket notes, it should be a useful disc nevertheless, for those who wish to learn while they sing.

Mind you, I imagine that Roger Wagner's main idea was to entertain and this the record does in a very pleasant manner, whether or not you set any store by the original French setting.

"Aupres De Ma Blonde," "La Marseillaise," "Song From Moulin Rouge," "Frere Jacques," "Mon Amour," "En Passant Par La Lorraine," "Au Clair De La Lune," "Vive L'Amour," "Le Regiment De Sambre-Et-Meuse," "Alouette," "Parlez-Moi D'Amour," "Sur Le Pont D'Avignon," "Fais Dodo, Colas, Mon Petit Frere," "Plaisir D'Amour."

The sound of the disc is smooth and clean and the stereo nicely spread. Bon; tres bon! (W.N.W.)

★ ★ ★

BENNY GOODMAN and his Orchestra Featuring GREAT VOCALISTS OF OUR TIMES — Buddy Clark, Ella Fitzgerald, Johnny Mercer, Jimmy Rushing, Martha Tilton, Helen Ward. RCA "Camden" Stereo, CAS-872. (Also available in mono.)

Interest: Top vocalists of the late thirties.

Performance: Individually good.

Quality: Fair.

Stereo: A reasonable imitation.

In or around the 1930s popular music underwent a change which has persisted to the present day. In the earlier years, jazz and swing bands had dominated the field but the production of better quality microphones at a reasonable price inspired many bands to use a vocalist in their arrangements and popular music gradually became vocal-dominated.

The Benny Goodman orchestra was one of the first to feature vocalists in their arrangements and Goodman himself showed an almost uncanny knack for discovering and grooming outstanding singers — among them the great vocalists which can be heard on this new disc.

The style and orchestral presenta-

tion of these artists is, perhaps, a little old fashioned by today's standard, but they all show that vocal "something" which has enabled many of them to endure and even remain on top in today's competitive vocal market.

The audio quality of the disc is quite fair and the stereo a pretty good imitation, even though it only divides the channels in terms of frequency response. A disc for the nostalgic. (K.W.J.)

★ ★ ★

DEAR HEART and Other Songs About Love. The orchestra and chorus of Henry Mancini. RCA Dynagroove 12-inch stereo, LSP-2990.

Interest: Mancini arrangements.

Performance: Warm, fresh sound.

Recording: Excellent.

Stereo: Widespread.

A dozen more goodies from Henry Mancini, this time all vocal arrangements of tunes connected with "Love." As with his previous albums, the music has that tantalising sweet-and-sour sound of familiar pieces dressed up in new and fresh ways: further evidence attesting to the ability of the composer of "Moon River," "Days of Wine and Roses," "Peter Gunn" and so many more.

The pieces presented are "Dear Heart," "The Girl from Ipanema," "Mr Lucky," "Soldier in the Rain," "I Love You and Don't You Forget It," "Song About Love," "How Soon" (theme from the Richard Boone Show), "The New Frankie and Johnnie Song," "Mostly for Lovers," "Man's Favourite Sport," "Can't Buy Me Love" and "Dream." Particularly enjoyable are Mancini's recent compositions "Dear Heart" and "How Soon."

The recording is of excellent quality, Dynagroove at its best. The stereo is smoothly and widely spread.

Warmly recommended. (J.R.)

★ ★ ★

SILVER ANNIVERSARY — Liberace. Highlights from "The Fabulous Career of 'Mr Showmanship'." Dot 12-inch stereo, SZL931,674.

Interest: "Mr Showmanship."

Performance: Schmaltzy but good.

Recording: Excellent.

Stereo Quality: Fine.

More for Liberace fans: A condensed musical history of his career. This may sound a little corny, but the disc certainly doesn't; it makes very pleasant listening. Schmaltzy, to be sure, but "Mr Showmanship" certainly can play that piano. Whether it be a "good-time" tune, an "old smoothie," a mock-solemn piece or a popular classic he makes very relaxed listening. And I suppose everyone likes a little schmaltz at some time or another...

The tunes he plays this time are "Rhapsody in Blue," "You Made Me

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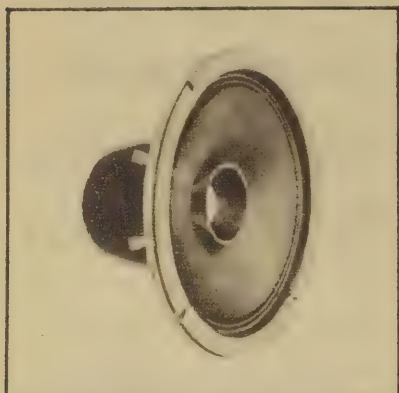
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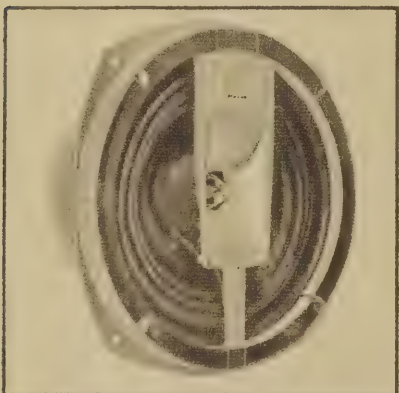
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Love You," "The Blue Danube," "The Rosary," "Tea for Two," "Boogie Woogie," "Paderewski's Minuet," "I Don't Care As Long As You Care for Me" and the Liszt Concerto in A Major.

The recording is of excellent quality, with negligible noise and distortion. The stereo is variable, but this is understandable as the tracks come from a variety of sources. It's unimportant.

A very pleasant disc. (J.R.)

★ ★ ★

MEXICAN PEARLS. Billy Vaughn and his orchestra. Stereo, Dot (Festival). SZL-931,660. (Also available in mono).

Interest: Melody, rhythm.

Performance: Very smooth.

Quality: First rate.

Stereo: Natural spread.

From the smooth, melodic sax, which is featured in most of the numbers, one could readily pick this as a Billy Vaughn offering, without ever having seen the jacket. It is distinguished, however, by the sound and tempo of the accompaniments which are Mexican in derivation but solidly worked over by Billy Vaughn and Milt Rogers to match the lyrics:

"Mexican Pearls," "Blue Orchids," "Heart and Soul," "A Melody From The Sky," "Just One More Chance," "Love In Bloom," "Dear Heart," "It's Easy To Remember," "Love Letters," "The Nearness Of You," "Willow Weep For Me," "Stella By Starlight."

Yes, it's very smooth, very easy on the ear, very well recorded. Recommended. (W.N.W.)

★ ★ ★

12 GOLDEN HITS FROM LATIN AMERICA, Billy Vaughan and his Orchestra. Stereo, Dot (Festival), SZL-931,739. (Also available in mono ZL-31,739.)

Interest: Gambolling sax.

Performance: Bright.

Quality: Good.

Stereo: Normal.

These are gay, foot-tapping melodies presented in a style which should appeal to the young and not so young. When Billy plays, it is hard to resist the urge to get up and circle the floor. While the background orchestration is good the appearance of Billy's saxophone makes the rhythm really spring to life.

The track titles: "Mambo Jambo," "Acerate Mas," "El Cumbanchero," "Adios Mariquita Linda," "Corazon de Melon," "Noche de Ronda," "Quien Sera," "Contigo," "Incertidumbre," "Sabor A Mi," "Perdoname Mi Vida" and "El Dia."

A recommended disc for those who like swinging Latin-American music. (K.W.)

★ ★ ★

THE BEST OF "SDS"—12 Tracks from 12 King Stereo Records. Festival 12-inch stereo, SFL-931-735.

Interest: Stereo sampler.

Performance: Sparkling "big" sound.

Recording: Excellent.

Stereo Quality: Doctored dramatically.

Another stereo sampler, this time from King Records in Japan. A collection of spectacular tracks from a dozen King discs, eminently suitable for showing off a new stereo system. The sound is high, wide and sparkling—unashamedly "doctored" with King's "Super Dynamic Sound" processing.

The tunes are "Bim Bam Boom," "String Of Pearls," "Moon River,"

"Mambo No. 5," "On The Street Where You Live," "National Emblem," "Let's Dance," "El Amancer," "Little Grass Shack in Kealakekua," "Ballad of Davy Crockett," Theme from "A Summer Place" and "Lady Of Spain."

Excellent as stereo samplers go, and fine for relaxed listening as well. (J. R.)

★ ★ ★

SHORT AND SWEET. Frankie Carle, His Piano and Orchestra, Produced by Neely Plumb. Stereo, R.C.A. Dynagroove LSP-3300. (Also available in mono).

Interest: Listenable, danceable piano/orchestra.

Performance: Pleasing.

Quality: Excellent.

Stereo: Adequate spread.

Frankie Carle's "gimmick" here is a group of popular tunes, all "miniatures" to the "16-bar" formula. Beyond the fact that it provides a title, I doubt that reason for the selection will excite many non-technical listeners. What is much more to the point is that Frankie Carle is in very good form indeed, as he provides a highly listenable selection of "16 Tunes With A Dancing Beat."

"A Lover's Lullaby," "Street Of Dreams," "Honey," "It's Been A Long, Long Time," "Shine On Harvest Moon," "Paper Doll," "I Don't Know Why," "Hair Of Gold, Eyes Of Blue," "How Come You Do Me Like You Do," "Falling Leaves," "Cuddle Up A Little Closer," "Love, Your Spell Is Everywhere," "I Don't Want To Meet Any More People," "Hands Across The Table," "It Must be true," and "Ja-Da."

For those with a special interest in quality, the sound is very smooth and clean, with generous rhythm bass. The stereo is good too. (W.N.W.)

★ ★ ★

HOLLYWOOD FAVOURITES. Ethel Smith, Electronic Organ with Orchestra. Stereo, Festival SDL-931,709. (Also available in mono DL-31,709).

Interest: Popular electronic organ.

Performance: Flawless.

Quality: Normal.

Stereo: Normal.

Many years ago, when electronic organs first made their appearance, our late editor John Moyle remarked that he didn't care much for them — they sounded "too much like a person playing their amplifier." I thought of this again as I listened to Ethel Smith, chirping away merrily in this new LP. She's precise, rhythmic, dextrous, she selects a variety of tempos but the organ voicing never varies much from the standard "Hammond popular mixture."

It is simply a matter whether or not you like organs played in this fashion. If you do, then you'll certainly enjoy this one. And, if you're a fan of Ethel Smith in particular, I doubt that you'll get a better portrait than the one on the jacket.

The selections, Hollywood favourites, most of them in dance tempo are: "Charade," "Dear Heart," "Love Is A

LOCAL DISC "A WINNER"

THE TRIO ORFEO at "La Taverne." Guitarists/vocalists. R.C.A. 12 inch stereo, SL-101622. Also in mono, on L-101622.

Interest: Popular trio.

Performance: Top-notch.

Recording: Excellent.

Stereo Quality: Wide, smooth.

Wow! Full marks to R.C.A. for this splendid locally-recorded disc of the highly-talented Trio Orfeo playing at the Edgecliff restaurant "La Taverne." For both performance and recording it wins my vote as the best local recording for many a long day.

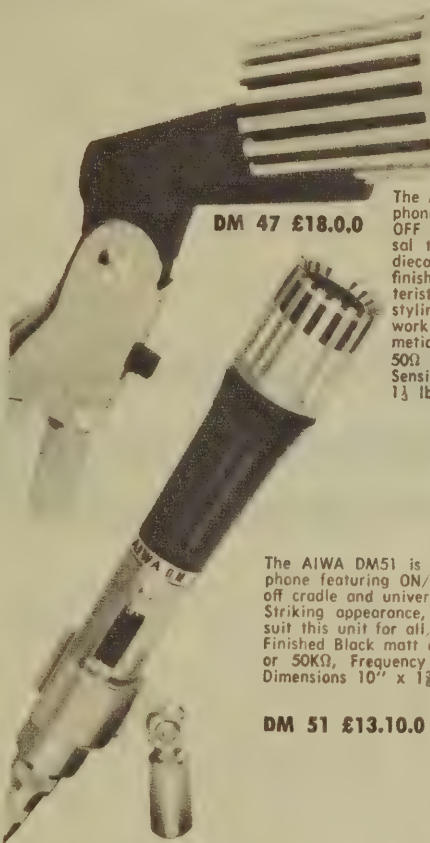
The trio comprises three young Greek guitarists-vocalists: Con Theofanopoulos, tenor, Jimmy Haramis, bass, and Basil Varikos, baritone. They play together as one; and on this disc they swing through a dozen lively but smooth arrangements of

"Never On Sunday," "Adventures In Paradise," "España Cani," "Ya Sena," "Ave Maria No Morro," "Tsitsanis' Solo," "Ikosara," "Quando Calienta El Sol," "The Green Leaves of Summer," Theme from "Zorba The Greek," "Pсарopoula" and "Mexican Hat Dance."

"Ya Sena" (For You) is Con Theofanopoulos' own composition; it reveals his considerable talent, and makes fine listening. But then, the whole disc is the same — really pleasant music.

And as I said, the recording is the equal of the performance: excellent in all respects. Crisp, clean sound, with excellent stereo presence and sparkle. A credit to all concerned, and certainly comparable with the best overseas recordings.

Recommended—a winner! (J.R.)



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The AIWA DM47 is a uni-directional dynamic microphone of exceptional quality fitted with sliding ON/OFF switch and tilting mounting base with universal thread for use with MS6 Floor stands. Tough diecast aluminium case with black and chrome finish. The DM47 featuring front sound (soloist) characteristics and high sensitivity together with excellent styling is designed specifically for the exacting work of professional recording. Replaceable hermetically sealed polyester-film diaphragm. Impedance 50Ω or 50KΩ, Frequency response 40-18,000 cps, Sensitivity 75 d.b., Dimensions 5½" x 1½", Weight 1½ lbs. with cord.

AIWA
DM51. G

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DM 51 £13.10.0

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DM14. G

The AIWA DM14 is a high quality non-directional physically compact dynamic microphone. Complete with light table stand and fitted with fly off cradle. The fine characteristics and physical dimensions of this model suit it ideally for use with quality T/recording, grams and general recording work. Grey enamel finish with chrome trim. Impedance 50Ω or 50KΩ, Frequency response 100-10,000 cps, Sensitivity 75 d.b., Dimensions 3¾" x 1", Weight 9½ ozs.

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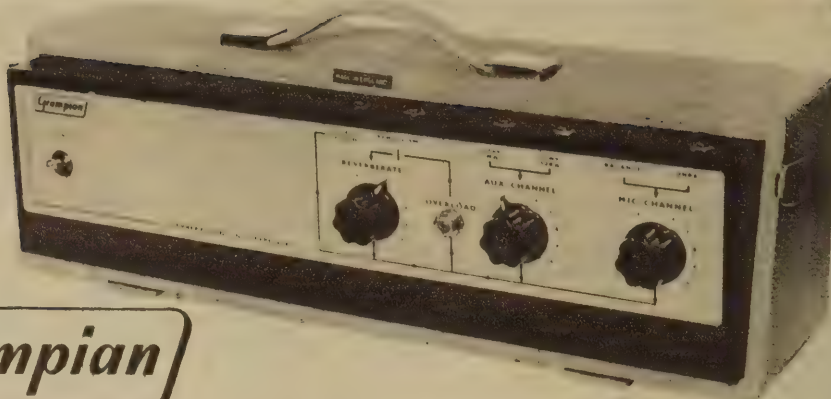


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Technically, the disc is well up to normal stereo standards which, these days, leave little to be desired. (W.N.W.)

★ ★ ★
STEREO SAMPLER, King Records, Japan. Stereo, King (Festival) SFL-2/3.

Interest: What King can do.
Performance: Well above average.
Quality: Some tracing distortion.
Stereo: Spread, separation outstanding.
"Sampler" records are usually worth close scrutiny because they are attractively priced (in this case 39/6) and because they usually contain items carefully selected for musical merit and technical quality.

Although I have spoken very highly of King records in the past, I was frankly rather disappointed with this sampler—or, at any rate, with my particular pressing. The music exhibits the undoubted virtuosity of the King Company's artists, the frequency response is wide and the stereo spread is outstanding, as it generally manages to be. But the tracks, particularly on side 1, just didn't have the ultimate quality that I had hoped to hear; either that or the modulation was just too much for my typical magnetic pickup.

On this sampler you will hear: "La Cumparsita," "Moonlight Serenade," "Johnny Guitar," "Hawaiian Wedding Song," "Maria," "The Peanut Vendor," "Moon River," "Smoke Gets In Your Eyes," "I Left My Heart In San Francisco," "Coppelia."

Yes, it's a good record, well worth its price if you like the numbers, but certainly not perfect. (W.N.W.)

★ ★ ★
SOMETHING TO REMEMBER YOU BY. The Melachrino Strings and Orchestra. Stereo, RCA Dynagroove LSP3398. (Also available in mono.)
Interest: Schwartz and Dietz.
Performance: Average.
Quality: Good.

A smooth presentation of melodies by Schwartz and Dietz, designed to recall nostalgic memories; an ideal background for dining with soft candle-light. Highlight of this record is the evergreen "Dancing in the Dark."

The other tracks which I felt stood out

RICHARD TAUBER — Recommended

THE ROMANTIC VOICE OF RICHARD TAUBER. With orchestra conducted by Henry Geehl. Mono, Parlophone Odeon PMAO-7008.
Interest: Great tenor.
Performance: Characteristic but good.
Quality: Excellent for its era.

The famous Viennese operatic tenor is remembered for different reasons by different groups of people.

For his interpretations of Mozart, for his roles in opera and operetta for his singing of popular romantic songs.

These last are featured on this new disc — hence the title. If you happen to be one of the many who had a soft spot for Richard Tauber in this role, monologues, mannerisms and all, you won't want to miss it. Nor are

over the others were "Louisiana Hayride" and "I guess I'll Have to Change My Plan." Other titles are: "Something to Remember You By," "A Shine on Your Shoes," "Moanin' Low," "If There Is Someone Lovelier Than You," "Waitin' for the Evening Train," "Alone Together," "I See Your Face Before Me," "New Sun in the Sky," and "By Myself."

The quality of the pressing is good and it can be recommended to those who like to relax and drift back over the years. (K. W.)

★ ★ ★
DANCETIME, Sammy Kaye and His Orchestra. Festival 12 inch Stereo, SDL-931,737. (Also available in Mono.)

Interest: Instrumental Fox Trots.
Performance: Smooth.
Recording: Good.
Stereo Quality: Well spread.

Well known melodies presented in a smooth style make this record a good choice for your dance album. Of the tracks featured we could only criticise the title song from the James Bond picture, "Goldfinger." I feel that the cacophony of brass instruments in this track was out of touch with the theme of the remaining tracks.

Very ably presented, and of certain interest to Beatle fans, is Eight Days of the Week. Tracks other than these mentioned above: "Red Roses for a Blue Lady," "Dear Heart," "If I Loved You," "Sophia," "You're Nobody 'Til Somebody Loves You," "Cry," "Blue Prelude," "My Love Forgive Me," "Willow Weep for Me" and "The Night Walker."

The track titles almost read like a hit parade and it seems inevitable that this record should prove popular for dancing and listening. (K.W.)

★ ★ ★
TRADE WINDS—Earl Grant, organ and piano with instrumental accompaniment. Universal Record Club, 12-inch stereo, SUP-7111. Also in mono, on UP-711.

Interest: "Romantic" organ, piano.
Performance: Smooth, languorous.
Recording: Excellent.
Stereo Quality: Good.

A quiet, dreamy, "romantic" disc from Earl Grant, the well-known organist-pianist. With rhythm and instrumental accompaniment now and then he meanders languorously but masterfully through "Trade Winds," "The Girl from Ipanema," "Street of Dreams," "Moon of Manakoor," "Eternally," "Quiet Vil-

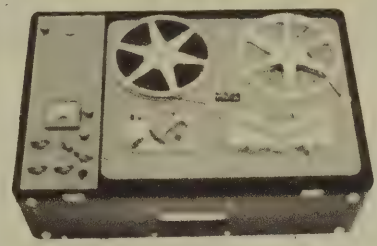
you likely to feel let-down, as sometimes happens with dubbing from old recordings. Tauber's voice will match your fondest nostalgic memories.

The titles: "Speak To Me Of Love," "Marcheta," "When Day Is Done," "Only A Rose," "Kiss Me Again," "Solitude," "Love, Here Is My Heart," "I'll See You Again," "The World Is Waiting For The Sunrise," "Sleepy Lagoon," "All The Things You Are."

To E.M.I. engineers must go the credit for lifting the recordings from whatever sources they had to this LP disc. The response is somewhat limited at the top end, though only hi-fi fans will notice it, but there is no background noise and only a few isolated instances of distortion.

One that I can recommend. (W.N.W.)

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age," "Sweet Leilani," "Ruby," "Meditation," "How High The Moon," "Love Theme from 'El Cid'" and "Summertime in Venice."

It makes very pleasant listening, and would be fine for quiet parties or "evenings at home." The recording is fine. (J.R.)

★ ★ ★

EARLY ELLA—Great Ballads by Ella Fitzgerald. "Mixed Emotions," "It's Too Soon To Know," "Baby Doll," "Walkin' By The River," "Melancholy Me," "Someone Like You," "I Hadn't Anyone Till You," "Do You Really Love Me," "So Long," "Gee, But I'm Glad To Know You Love Me," "Even As You And I," "Crying." Universal Record Club, Mono. UJ-662.

Interest: Ella in the 40s.

Performance: Always good.

Quality: Variable.

The tracks on this disc were cut during the period 1940 and 1953 when Ella Fitzgerald had firmly established herself as a top vocalist and had, in fact, taken over the nominal leadership of the famous Chick Webb Orchestra with which she got her early start in the 30s.

Ella is perhaps best known for her jazz vocals but she is equally at home with a good ballad, as her performance on this disc aptly demonstrates. Despite a marvellous vocal technique she has no easily identifiable tricks or gimmicks but simply enhances each number with a superior musicianship which unfailingly respects the songwriter's intentions.

The audio quality on the disc is somewhat variable although about as good as could be expected for the years of production. (K.W.J.)

★ ★ ★

35 SELECTIONS FROM GREAT OPERETTAS—The Vienna State Orchestra and The Vienna Orchestra under the direction of Hans Hagen. Festival, Stereo. SLF-931-699. (Also available in Mono.)

Interest: Background operetta favourites.

Performance: Tasteful.

Quality: Excellent.

Stereo: Even spread.

This disc features a tasteful selection of easily recognised tunes from some of the great operettas of the past. The Vienna State Opera Orchestra, in which stringed instruments predominate, plays

MODERN JAZZ

THE SHERIFF, featuring the Modern Jazz Quartet. "The Sheriff," "In A Crowd," "Bachianas Brasileras," "Mean To Me," "Natural Affection," "Donnie's Theme," "Carnival." Universal Record Club, Mono. UJ-713.

Interest: Modern jazz.

Performance: First-class.

Quality: Good.

The MJQ are deservedly famous for their playing, as a quartet, of formalised compositions in the classic sense and a majority of the numbers on this disc follow this pattern. The exceptions are "Donnie's Theme," which is a straight 32-bar swinger in C Minor with an E Flat release, and "The Sheriff," which is also fairly straight and in which Lewis relies on a formula, for the main phrase, that has enjoyed cur-

those numbers which demand a smooth treatment of the melodic line while The Vienna Orchestra is featured on those which require a more forceful, brassy treatment.

The disc makes very pleasant background music which, with a constant change of both orchestra's and tunes, is never boring and always entertaining.

The full list of tunes played is too numerous to present here but the following operettas are represented: "The Dubarry," "The Merry Widow," "The Waltz Dream," "White Horse Inn," "Paganini," "Countess Mariza," "The Laughing Groom," "Marietta," "The Tzarist," "Friederike," "Clivia" and many others.

The audio quality of the disc is good throughout and the stereo has a nice, even spread. Recommended. (K.W.J.)

★ ★ ★

CAROL CHANNING ENTERTAINS, Arrangements by Lew Davies and Robert Byrne. Originated and produced by Enoch Light. "Elegance," "I'll Die Happy," "Mean To Me," "When You're Smiling," "Baby, Won't You Please Come Home?" "Dear Hearts And Gentle People," "Widow's Weeds," "Makin' Whoopee," "Ain't Misbehavin'," "Home-sick Blues," "You've Gotta See Momma Every Night," "Bye Bye Blackbird." Command, Mono. NDL-31,694.

Interest: Carol Channing.

Performance: Well . . .

Quality: Excellent.

I am told that Carol Channing is a tallish and most attractive blonde who has a great personality. From her impressive list of Broadway successes (she is currently the star of "Hello Dolly") I must conclude that she is also an excellent actress.

On this disc, however, we are confronted with her disembodied voice and, quite frankly, I found this not a bit entertaining. In fact, it was quite nauseating. Her unpleasant accent and silly, simpering approach to most numbers might be tolerable when coupled with her visual image, but as straight audio it's an unpleasant experience — at least as far as I'm concerned.

As if to compensate for Miss Channing's voice, the audio quality of the disc is really excellent, as is Enoch Light's backing. (K.W.J.)

rency among jazzmen for a good quarter-century.

The best track on the disc, in my book, is "Bachianas Brasileras," which is a composition by Heitor Vill-Lobos and one of the works performed by Laurindo Almeida with the MJQ at the 1963 Monterey Jazz Festival. Milt Jackson is superb on this track, particularly in his use of grace notes and the slight delays so characteristic of his acute sense of timing.

In "Carnival" and "Natural Affection," the group turn to a bossa nova beat, a rhythm for which John Lewis has expressed a frank admiration.

The audio quality is generally very good, although there are one or two places in which the heavily recorded vibraharp has produced groove modulations that only the very best of pickups will be able to follow. (K.W.J.)

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TRADE REVIEWS AND RELEASES

THE BEOCORD 2000 SYSTEM: *integrated hi-fi and stereo tape*

The "Beocord 2000" stereo tape recorder pictured has features which should make it of interest to almost every audio enthusiast and hi-fi fan. Fully transistorised, it is designed so that it may be used as the heart of the stereo system rather than as an "add-on"; the inbuilt power amplifiers and magnetic pickup preamps give full-scale performance with convenience of operation. Made by the Danish firm of Bang and Olufsen, it was sent for review by G.R.D. Instruments Pty. Ltd.

At some stage or other, the majority of hi-fi enthusiasts desire to add tape to their system—either as a permanent facility, fixed in position with the rest of the equipment, or as a mobile facility which can connect into the system as required.

The addition usually involves either a complex and somewhat inconvenient system of interconnection cables or a rather wasteful duplication of equipment and functions.

If the user wishes to use the tape machine as a mobile facility, the inconvenience and/or inefficiency is usually accepted as the price which must be paid.

The enthusiast who requires only a fixed tape facility is in a rather different situation; since he does not require the tape machine to be available as a self-contained and isolated unit, it is most desirable from his point of view to incorporate the tape equipment as much as possible into the system. By doing this he obtains the "most" performance from the "least" equipment and cash outlay; costly duplication and complex interconnections are kept to a minimum.

To date, the conventional approach in the latter types of application has been to add a so-called "adapter" tape machine to the system; this type of machine lacks output amplifiers and speakers, and it will thus combine economically with a standard system. However, this approach is by no means the best possible one; very often wasteful duplication of preamplifiers and tone controls still occurs, and there are often more interconnections than one would like.

B & O appear to solve this problem rather well by adopting another approach; making the stereo tape machine the heart of the system rather than an add-on unit. As the elements of a tape machine include those of an amplifier system, this quite logical move permits the designer to make almost all essential interconnections within the machine and combine functional versatility with straightforward and convenient operation.

That this procedure pays off well for both designer and user becomes evident after some time spent using the Beocord 2000 and reading through its accompanying 55-page guide booklet. The number of functions which may be performed with this machine is most impressive, yet careful design has kept operating complexity to the point when it is only slightly greater than that associated with a standard mono recorder plus ancillaries.

And, lest the initial discussion gave the impression that a "heart of the system" tape machine like the 2000 must of necessity be something of a monster, the table model shown measures only 17.7in x 14in x 7.5in, including lid; it weighs only 35 pounds. Well might it be said that B & O have incorporated the hi-fi system into the tape recorder rather than the tape recorder into the hi-fi system...

In other words, using the Beocord, one can have a completely portable stereo system no larger than a typical stereo recorder—having one's cake and eating it as well. In fact, B & O anticipate this by making available a suitcase version, with split-lid speakers. Both versions are available in either 2-track or 4-track models.

The tape transport or "deck" is powered by a single Papst external-rotor synchronous motor, the motor being operated from the



power transformer used to power the amplifier system. This allows the machine to be operated from any mains voltage between about 95 and 240V AC.

The deck itself is of solid construction and features professional type swinging-arm tape tension adjusters between each spool and the head/capstan block. This results in very stable tape motion and even spooling. The deck provides three speeds—7.5ips, 3.75ips and 1.875ips, these being selected mechanically with a rubber intermediate wheel and step pulley. Forward and reverse spooling are a little slow compared with three-motor decks, as one would expect from a single motor deck, but they are quite reasonable.

Both mechanical and electrical automatic stop devices are fitted. The record and play heads are not fitted with pressure pads as such, but the erase head is fitted with a velvet-faced shoe to ensure efficient erase. A moving shield is used on the replay head to reduce hum pickup. A locking type pause control is fitted, and there is a three-digit tape counter which is reset at the touch of a button. The two-track version is fitted with two separate erase heads.

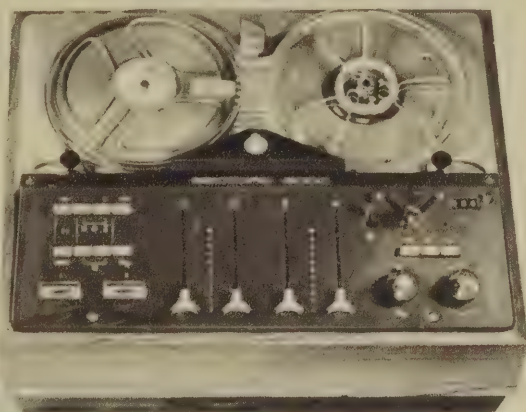
Operation of the deck is very straightforward. Tape motion is controlled by a four-position "joystick" control and a rotary speed selector/mains switch between the spools. Braking is smooth and swift; we

were unable to produce tape spillage despite our efforts to show up any tendency in this regard. Speed recovery after release of the pause control is notably rapid and stable.

The electronics of the Beocord 2000 are fully transistorised; some 36 transistors and three diodes are employed. Most of the circuit sections are mounted on plug-in printed wiring boards for easy service or replacement.

Three stereo inputs are provided, each with appropriate preamps. For both recording and "straight" amplification all inputs may be mixed as desired and, in addition, it is possible to mix in the signals from the replay heads for track-to-track re-recording or echo. The mixing controls are of the professional "slider" type and are most convenient to use.

As supplied, the preamps fitted are for low-medium impedance dynamic microphones, MAGNETIC pickup and low-output radio tuner. Adapter boards may be obtained to convert the pickup inputs to suit crystal pickups and the tuner inputs to suit high-output tuners or amplifiers. Appropriate equalisation is applied in all



Above is the Beocord 2000, fully transistorised stereo amplifier and recorder. At left, the companion record player by S.R.T.

cases. All connections to the machine are via international standard DIN connectors.

The replay preamps are equalised for the three operating speeds according to CCIR standards, the equalisation being switched with the deck speed control. Push-button switches allow any combination of mono/stereo replay, and similar switches allow selection of recording modes. Recording level is monitored using two illuminated edge-type meters.

The power amplifiers of the 2000 may be switched to the replay preamps for tape replay or to the input preamps directly for "straight" amplification. Ganged bass and treble controls are fitted, also a balance control. Two sets of speakers may be connected and selected by push buttons; the speakers may also be replaced by an internal dummy load for muting or ear-phone monitoring. The replay volume control is a slider type, and is fitted with L.F. "loudness" compensation at low settings.

Rated output from the amplifiers is 8 watts, with a rated speaker impedance of 4 ohms. The rated frequency response at 7.5ips is 30cps-20KC, at 3.75ips 30cps-16KC, and at 1.875ips 50cps-8KC, with 2dB down points at 16KC, 12KC and 6KC respectively. Signal-to-noise ratio is quoted as 55dB for the 2-track model, relative to a recording signal producing 3 per cent distortion, and channel separation at 45dB or better.

Before giving our test findings in this regard it would seem worthwhile to digress for a moment concerning test conditions. The Beocord 2000 has a very fine reputation, and when we learned that a unit was to be sent to us for review we took

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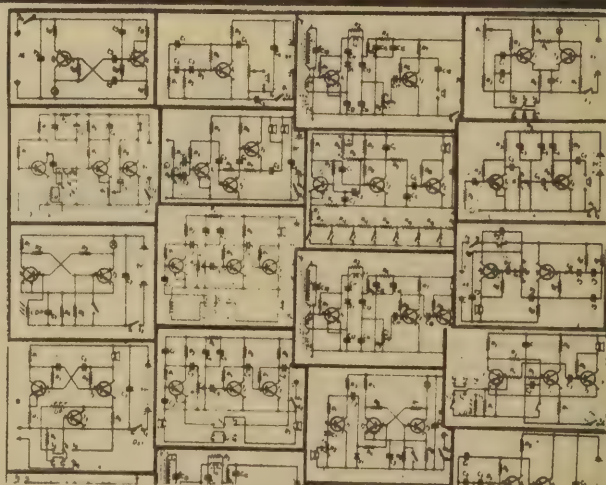
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the obvious step of reading its reviews in overseas journals.

This research yielded two principal items of information: one was that all reviewers had liked the machine very much — "raved" over it, in fact — and the other was that very few had bothered to mention the conditions under which they carried out the various tests. The latter is by no means unusual, but it makes it very difficult for anyone reading the reviews to gain the full amount of data from them.

As an example take the question of frequency response. Just what do published figures mean? Assuming that the amplitude tolerance is quoted (and it often isn't. . .), the figures still don't mean very much unless it is also stated just which input was used to feed signals into the machine, the position of the controls, the function under test and the loading and output connections used.

The question of inputs is important because different input signals receive different equalisation; the position of controls is important because tone controls and loudness-type volume controls will both influence response; the function under test is important because the response of the recording or replay amplifiers alone is usually somewhat superior to the response of the complete system; and finally the output connections and loading are important because, very often, power amplifiers have a poorer response than the small-signal circuitry.

The above considerations are from the point of view of frequency response measurement; many of these, together with other factors, will play a large part in influencing the measurement of other performance parameters such as signal-to-noise ratio, distortion, crosstalk, etc. Not only should one ideally know the test conditions in order to verify them; one should also know them in order to relate them to the performance of the equipment during normal use.

RESPONSE FROM WHERE?

For example, there seems little point in performance of the equipment during frequency response taken from a low-level output jack, in the case of a machine where the output stages have a relatively poor frequency response. Since the output stages are going to be used in normal operation, the overall response of the system including these stages will be the prime consideration; the average user will not be very impressed to learn belatedly that, to obtain the quoted frequency response, he must provide his own external hi-fi output stages.

To return to the Beocord 2000: as we mentioned above, the overseas reviewers gave little indication of the test conditions employed to verify the manufacturer's specification. Perhaps this is understandable in view of the slight information given in this direction by B & O (and most other manufacturers, it should be added); however it is none-the-less undesirable because it must inevitably leave the way clear for the critical reader to ask whether the reviewer actually tested the machine or simply re-presented the specification as disguised advertising. And, of course, it results in all sorts of confusion, both real and apparent, for those who compare reviews with each other and with the original specification.

With the foregoing in mind, then, here are our findings:

The response of the amplifier system taken from the "radio" inputs to a speaker socket load with a 4 ohm resistive load with bass, treble, balance and volume controls (both "radio" and "replay") in the mechanical centre position was within 3dB from 20cps to 15KC. The response was quite smooth.

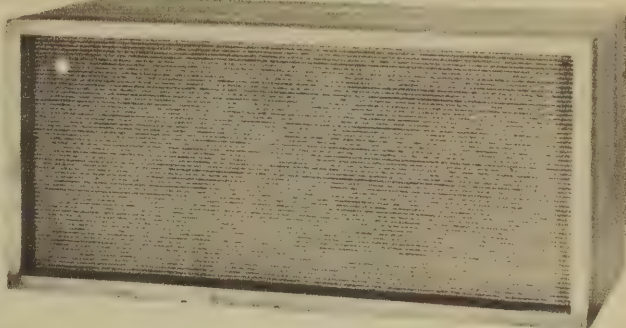
With the same load and control settings, apart from the use of the appropriate mixing slider, the response of the amplifier from the "magnetic pickup" inputs showed peaks of some 4dB at 40cps and 6KC.

This was measured, using a generator and standard 500mH series inductor to simulate the pickup impedance, and the curve was compared with the RIAA replay characteristic. Tests with the B & O "Stereodyne" magnetic pickup and the standard VSD-100 test record verified this result. The implication is that the pickup equalisation is slightly in error — but not seriously so and, in any case, capable of some correction using the tone controls.

The overall record-play response (again

faders at zero was better than 45dB; turning up any fader with open-circuited input degraded this figure by about 5dB. Crosstalk between the recording amplifier (at nominal recording level) and the "flat out" replay amplifiers was better than 60dB down from 6W output (tape stopped); crosstalk between channels, as measured by recording on one track at nominal level and replaying the other with "flat out" replay amplifier, approximately 42dB (rel. to 6W output). All tests involving tape

The B & O type M speaker enclosure, a compact unit of approximately 8 watts rating.



with a dummy speaker load) using the same magnetic pickup showed the same general trends — peaks at 40cps and 6KC. At 7.5ips the response was within 6dB from 20cps to 20KC, with the upper frequency for 6dB down at the two lower speeds being 8KC and 5KC respectively.

A second record-play run using the "radio" inputs showed a much smoother response — the curves for the three speeds were 3dB down at 15KC, 7KC and 4KC, and with a notably smooth and balanced characteristic.

Further tests using the low-level outputs available from the "radio" connector gave very similar results, indicating that the response of the system is fairly consistent throughout.

Using a 4-ohm dummy load the power stages would deliver some 6 watts RMS at 1KC with less than 1 per cent T.H.D. The maximum output was very close to the 8 watts specified. Overall record-play distortion at 1KC with the recording level corresponding to the beginning of the red "high" region on the level meters was less than 1.5 per cent. Incidentally, the meters differed by some 2dB with identical signals applied to both channels — a small point, but it could detract from the user appeal.

Replay system signal-to-noise ratio relative to 6W output was 50dB unweighted, and some 65dB ignoring the very low frequency (virtually inaudible) transistor noise. Overall record-replay S/N with the same reference level and with all input

were done on new, unused tape of high quality.

In short, then, the performance of the Beocord 2000 leaves very little to be desired for, although the figures quoted above do not correlate exactly with the specification or with those given by other reviewers, they compare very favourably indeed with the best recorders which we have tested in the past.

In fact, if the slight error in magnetic pickup equalisation is ignored as probably being caused by within-tolerance component variation, and considering the machine as a whole, there is little doubt that it is the most impressive stereo recorder which we have tested to date. It certainly represents excellent value for money.

Apart from the actual performance we especially liked: the sliding faders, the versatility and convenience of the push-button recording and replay selectors, the push-button instant reset on the tape counter, the reliable braking and instant speedup, and the attractive and functional smoky plastic dust cover.

With the 2000 came two of the B & O type "M" speaker enclosures, and the new type 643 player by S.R.T. The latter was used for tests with the Beocord, using a B & O type SP1 "Stereodyne" cartridge as previously mentioned.

The performance of the type M speakers

(Continued overleaf)

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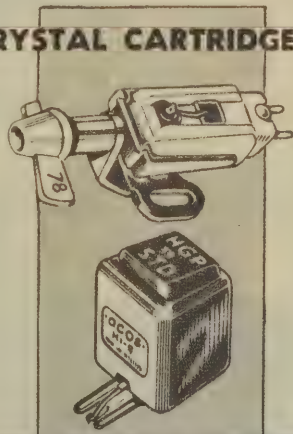
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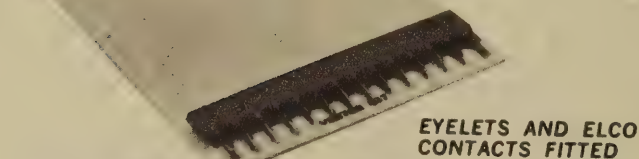
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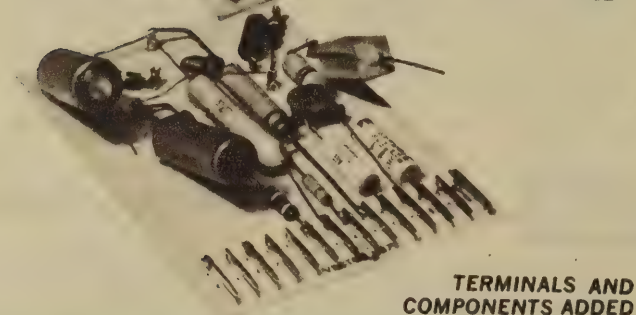
Illustrated below are the four basic stages in the production of a printed circuit wired prototype or plug-in module. Commencing with a blank epoxy paper or glass board, eyelets and Elco male contacts are added individually or in strip form. The plastic backing is then removed from the male contact strips (if necessary) so that components can be wired on to the circuit board, making use of Vector eyelets or the Mini-Klip terminals. When completed, the whole circuit can be plugged into an Elco 5000 or 7000 Series Connector receptacle.



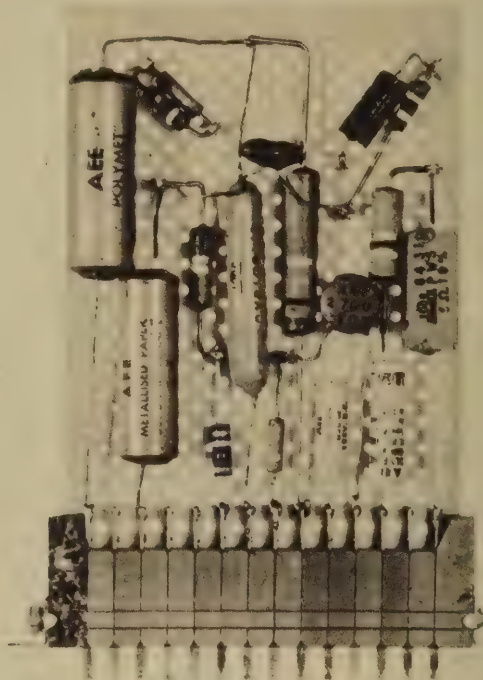
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was very pleasing, and rather similar to that of our own Bookshelf units. This is perhaps not surprising since the design and construction is very similar — sealed boxes, cellulose packing, six-inch "woofer" and small tweeter with simple half-section crossover network. Used with the 2000 they give high quality reproduction. (Note: the nominal impedance is 3.5-5.0 ohms.)

The SRT type 643 stereo player would appear to be a modernised version of the earlier type 574V reviewed in these columns in July 1960. It features a deeper turntable mat, a completely restyled arm and a new pickup lifting device for safe and convenient raising and lowering. Features retained from the earlier model are the renowned belt drive with asynchronous two-pole motor and centrifugal governor vernier speed adjuster, automatic stop and interchangeable head shells on the pickup arm. The latter have standard 1/2in mounting centres.

It comes complete on a teak-and-black wooden base which matches the styling of the Beocord; there is even a similar smoky plastic dustcover available as an optional extra. Alternative cartridges available are the SP1 magnetic unit or a "Merula" high-quality ceramic unit. The performance of the player is of a very high standard; it is a well-constructed unit and would be an ideal choice either as a companion to the Beocord or as part of a conventional stereo system.

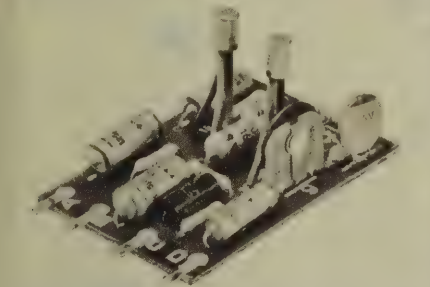
Retail prices are as follows: For the Beocord 2000, £225/7/3 in suitcase styling or £219/6/3 for the table model shown (4-track, £6/1/ extra). The type M speaker enclosures are £25/12/6 each; the SRT type 643 player with SP1 magnetic cartridge and transistor preamp (the latter not required for use with the Beocord) is quoted as £49/18/6 plus £6/18/9 for the wooden base and £2/1/7 for the plastic dust cover.

Two B & O ribbon microphones are available for use with the 2000, the multi-impedance mono type BM-4 at £25/4/6 and the stereo type BM-5 at £69/9/3.

Inquiries regarding the Beocord 2000 and the other products mentioned should be directed to G.R.D. Instruments Pty. Ltd., of 6 Railway Walk, Camberwell, Vic. (J.R.)

Preamp. For Pickups, Tapeheads, Mics.

R.C.S. RADIO Pty. Ltd. recently released the small many-purpose preamp shown, which fits into their standard small plastic box. Available as a kit, the preamp is based on the designs published in this magazine in November 1961, August 1962, December 1964 and July 1965. It is a mono



circuit and can be supplied for use with magnetic pickups, tape heads or dynamic microphones, with performance as originally specified.

Unless otherwise specified NPN transistors are supplied, as these enable the preamp to be used conveniently with valve equipment. As a kit the preamp is designated No. 672C, and costs £3/5/ plus 1/ postage; fully assembled, it is designated type No. 672D and costs £4 plus 1/. (R.C.S. Radio Pty. Ltd., 651 Forest Road, Bexley, N.S.W.)

INEXPENSIVE CRO PERFORMS WELL

Jacoby Mitchell & Co. Pty. Ltd. announce the release of the new model 539 oscilloscope manufactured by Kikusui Electronics Corp., of Japan.



THE model 539 is an extremely compact and lightweight instrument measuring only 4 by 7½ by 12½ inches and weighing 11½lbs. The unit is most attractively finished in a light grey crackle enamel with silvered front panel and black and red lettering. Its appearance, in fact, is very similar to a particularly expensive line of American equipment.

The instrument employs a basically simple circuit but its performance, despite this, is most impressive. The vertical amplifier is AC coupled, has a maximum sensitivity of 300 millivolts per centimetre and a bandwidth of 5cps to 1MC at the plus or minus 3DB points. A compensated switched attenuator provides sensitivity divisions of 10 and 50 and there is also a continuously variable control concentric with the attenuator switch.

The horizontal amplifier has a deflection sensitivity of 2 volts per centimetre and a frequency response of 1.5cps to 400KC within plus or minus 3DB. The time base extends from 10cps to 100KC through a four-position switch and a continuously variable control. A fifth position on the time base switch connects the horizontal amplifier to an external input terminal.

In our laboratory tests the instrument easily met all of its specifications and was particularly easy and pleasant to "drive." The trace is extremely fine and with a more than adequate brightness level sustained by an automatic brightness control at even the maximum time base speeds. Positive "locking" of time base was exhibited on all signals exceeding approximately 2 millimetres in amplitude and linearity of the sweep is excellent over the full range of speeds.

This would appear to be an excellent little unit with characteristics making it ideal for audio and general servicing work and, in fact, for the majority of TV service work.

The instrument is modestly priced at £55 and any further inquiries should be directed to Jacoby Mitchell and Co. Pty. Ltd. of 469 Kent Street, Sydney, N.S.W.

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TRADE NEWS...in brief

EMERSON AND CUMING, INC., of Canton, Massachusetts, announce the release of a new one-part adhesive to be known as Eccobond 85A. The new adhesive is a solvent type and has been designed especially for use in bonding problems of the electronics industry. It is said to be excellent for bonding polyacrylate (or polymethacrylate) to itself, or to other substrates including metal and wood. It will also provide bonds of moderate strength to plasticized polyvinyl chloride where epoxy adhesives are not effective. Eccobond 85A is water clear in appearance and has excellent resistance to dilute alkali and acids, alcohols, mineral oil and water. Its electrical resistance is high.

THE DEPARTMENT OF SUPPLY wishes to make general notification that, as from July 7, 1965, the administrative staff of the Approved Components Store (APCOS) will be located with the Central Office Staff at the Telecommunications and Electronics Section, Department of Supply, at 339 Swanston Street, Melbourne. The move will bring together APCOS and the Components Developments Group of the section and the resulting liaison is expected to benefit APCOS customers.

AEGIS MANUFACTURING CO. PTY. LTD. have recently released two inductors designed for the crossover networks used in the "Playmaster" bookshelf speakers. One is the type S.87, a 1mH unit intended for use with the 15 ohm system described in the December 1964 issue, and the other the type S.117, a 0.5mH unit for use



with the 7.5 ohm system described in July 1965. The price is the same in both cases, 28/- retail, including tax. The units should be available from all radio suppliers, and stocks are currently held by the N.S.W. Aegis distributors, Watkin Wynne Pty. Ltd., 32 Falcon Street, Crow's Nest.

PLESSEY-U.K. LTD. recently announced two new relays for the electronics industry. One is a miniature dry reed relay designed to meet the particular requirements of printed circuit board mounting.

It incorporates an intermediate size reed and is suitable for switching loads from dry circuit to 0.5 amps (max) resistive. Using reed contacts in a sealed envelope enables this component to provide a high switching speed coupled with long life. It is thus particularly suitable for use in light duty circuits such as computer logic switching.

The reed and coil assembly is sealed into a plastic shell which absorbs shocks arising from any mechanical environment and provides protection to the relay coil in the case of climatic extremes.

Standard coil voltages are 6, 12 and 24 volts DC. The maximum contact rating is 0.5 amps DC, resistive, at 28 volts 3 watts.

The other relay is the Type CJ, designed by the Professional Components Division of Plessey-U.K. primarily for missile applications. Weighing only 3.5gms, it is capable of switching loads up to .5A at 28V DC (resistive). For maximum reliability, the coil is sealed off from the contact area, and no organic materials are used. The changeover contacts have a resistance of 100 milliohms (maximum) and a life (minimum) of 10 operations.

The Type CJ is designed to fit into a TO-5 type transistor can, and employs a highly efficient magnetic circuit. Semi-conductor techniques are used throughout its manufacture, including welding of the can to the glass sealed base. Lead out wires are gold plated and a variety of contact materials can be used to cater for specific circuit applications. The operate and release time is 3.5 milliseconds maximum including bounce time. The component has a temperature category of -65 deg. C to 125 deg. C, a shock factor of 100g for 11 milliseconds and acceleration of 100g.

Further details in Australia from Ducon Condenser Pty. Ltd., Box 2, Villawood, N.S.W.

FERRIS BROS. PTY. LTD. announce the release of their model 156 "Coachliner" push button bus receiver with PA facilities. The "Coachliner" is intended primarily for use in buses where both radio programs and public address an-



nouncements are required. It may also be used in ferries or pleasure craft, or small public halls without 240AC supply. The set uses nine transistors and combines high RF sensitivity with a high power (10 watt) push-pull output stage. A specially designed dynamic microphone on an adjustable arm is available. Independent controls for radio and PA permit smooth changeover from one model to the other. Price: for the receiver only, £56.

TECNICO ELECTRONICS PTY. LTD. are now offering a range of adjustable filters with digital frequency selection manufactured by Dytronics Inc. of U.S.A. These filters cover from 0.1 cps through 100KC frequency range. Various models feature adjustable lower and upper cut-off characteristics and a notch filter is also available. All models feature digital frequency selection.

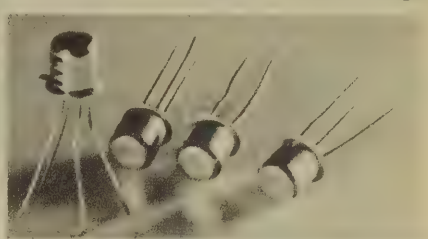


Tecnico are also marketing a range of English "Newmarket" packaged transformerless transistor amplifiers, two of which are shown here. Power outputs available range from 150mW to 3W, the highest power unit operating from 12V but the rest from 9V. Frequency response is generally better than 12KC, with less than 6 per cent distortion. Load resistance requirements vary from 40 to 3 ohms, and input impedances from 1K to 220K. Input sensitivities are from 2mV up.

Prices of the compact little amplifiers range from 49/11 to 124/6. Inquiries to Tecnico Electronics Pty. Ltd., 53 Carrington Road, Marrickville, N.S.W.

MULLARD-AUSTRALIA Pty. Ltd., announce the release of four new silicon planar epitaxial transistors: the RF-IF type BF115, and the AF types BC107, BC108 and BC109. All four are NPN types and are packaged in the compact TO-18 metal case.

The BF115 is intended as a multi-use high



frequency transistor; its transition frequency (unity Beta) is typically 230MC, making it suitable for many applications up into the VHF. Typical noise figure at 100MC is 3.6dB; maximum dissipation is 140mW, with Vceo at 30V max.

The BC107-8-9 are related transistors, but differ somewhat in their intended application. The BC107 has a Vceo of 45V, and is intended for higher voltage applications; the BC108 is a 20V general purpose type; the BC109 is a selected low-noise type for preamp use. All three have a dissipation of 300mW at 25 degrees C., and have high gain.

Enquiries to Mullard-Australia Pty. Ltd., at 35-43 Clarence St., Sydney.

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7 watt all-transistor amplifier

(AC or Battery operated)

Smartly Styled Model PA746

This amplifier is a 240 volt AC unit or a portable battery powered unit for speech and music amplification. 12 volt DC operation makes the amplifier highly suitable for all types of mobile address work. The unit also operates from a 6 volt DC supply with a corresponding reduction in audio output. The attractive case is in sturdy black armorette with polished chrome trim.

Input and output facilities

Input and output facilities are as follows: 1. Crystal Microphone input, .4 megohms. 2. Dynamic Microphone input, low impedance. 3. Pick-up input, .5 megohms. 4. Output taps are provided at impedances of 600 ohms, 200 ohms and 100 ohms.

Amplifier performance

1. Sensitivity: On pick-up approximately .5V for full output. On microphone approximately 2mV for full output.
2. Frequency Response: With tone control at normal, response is substantially level from 50 cycles to 10 Kc.
3. Harmonic Content: Less than 5% at full output.

4. Noise Level: Pick-up input better than -60db below full output. Microphone input better than -30db below full output.

5. Tone Control: Operative on pick-up channel only. Gives a smooth cut to top frequencies with a full cut of -22db at 10 Kc in maximum clockwise position.

6. Power Consumption: 12 volt operation — approximately 1.35 amps. at full load condition, quiescent current 150 MA. 6 volt operation—1.2 amps. at full load condition, quiescent current 200 MA.

Specifications

CONNECTIONS

Mains connection by plug-in power cable. Battery connection by plug-in battery cable. 6V or 12V battery selection by screwdriver switch at rear.

TRANSISTORS

Microphone Preamps.	2N217	(2)
Main Amplifiers	2N217	(2)
Push-pull Drivers	2N270	(2)
Push-pull Output	2N301	(2)
B- supply Diode Rectifiers	1N1199A	(2)

DIMENSIONS

Width	5½"
Height	7½"
Length	13½"
Wt.	19 lbs.

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AMATEUR BAND NEWS AND NOTES

P.M.G. UPHOLDS AMATEUR RIGHTS

A statement believed to be the first official ruling concerning TV reception in fringe areas and interference caused by amateur radio transmitters was made recently by Mr J. R. O'Sullivan, Director of Posts and Telegraphs.

By Pierce Healy, VK2APQ*

THE statement was forwarded to Mr J. Mortimer, the Member for Grey, following complaints of interference to television reception in Port Pirie, South Australia, caused by amateur radio operators in the area.

In the January issue of these notes, a report was given on the investigations made by a radio inspector and local personalities into TV interference in that area.

Again, the city newspaper, "The Recorder," gives front page prominence to the subject and in an excellent editorial supports the local amateurs in their efforts to combat incorrect and unfair criticism of amateur radio operators.

Dated Friday, September 24, the editorial reads:

TV RECEPTION AND LOCAL RADIO OPERATORS

In a number of locations in Port Pirie, when local amateur radio operators come on the air, the quality of TV reception immediately deteriorates.

This is most annoying to the owners of the TV receivers and a constant worry to amateur radio operators; but does it follow that the radio operators should stay off the air to enable TV viewers to gain the best possible reception?

It might be that one radio operator is interfering with the TV enjoyment of dozens of people; and if you happen to be one of these people your answer will be an emphatic "Yes"—because you have paid your TV licence fee and you think you are entitled to the best possible reception.

The local radio operator was probably allocated a frequency long before TV became available and he has been working on that frequency efficiently for years; he owns expensive equipment, knows he is operating legitimately and wants to stay on the air to enjoy his hobby.

Who is right in this dispute? The answer can only come from the authority in charge of radio and TV—the Postmaster-General's Department, and its ruling is final.

The department has inferred that Port Pirie was never intended to pick up TV programs from Adelaide and if a person has a receiver in this city he must expect to put up with interference, even from radio operators as long as they are operating legitimately and their equipment is satisfactory.

The P.M.G. Department says, in effect, that people living in fringe areas such as Port Pirie will simply have to put up with unsatisfactory reception until a local station gets on the air. This is its policy and the Commonwealth Government is doing all it can to get local TV stations in areas which warrant them.

One could debate the value of radio

"hams" for hours and bring forth an impressive list of achievements—but what purposes would this serve?

The fact remains that Port Pirie's amateur radio operators are legally entitled to broadcast on a frequency allocated to them by the P.M.G. and if they interfere with TV reception in fringe areas — that is just too bad.

It is irrelevant that one radio operator may ruin the reception on dozens of TV sets.

Most of Port Pirie's amateur radio operators belong to the Port Pirie Amateur Radio Club and that body has expressed its concern over the interference it is causing. It has voluntarily restricted its hours of operation and has expressed a willingness to co-operate with the public — but it has no intention of going into voluntary liquidation just because the public wants to watch TV reception which was never intended to reach out this far from the source of transmission.

Let's face the obvious fact—when you and your neighbour bought your TV receiver you did not expect to get first-class reception, and consequently you have to put up with all kinds of interference, be it from sun spots, rain, storms or amateur radio operators.

STATEMENT

The full communication from the P.M.G.'s Department was given in the editorial, as follows:

"Dear Mr Mortimer,

"With the commencement of a television service through station ABNS operating from 'The Bluff' an increasing number of complaints of interference to the reception of Adelaide stations ADS, NWS and SAS has been received by this Department from viewers in the Port Pirie area as well as representations from Mr A. J. McDonald of 16 Harrison Crescent, Port Pirie, on behalf of the Port Pirie Amateur Radio Club.

"It would appear from these complaints and also from the publicity that has been given to the matter in the 'Port Pirie Recorder' that reception conditions in regard to the Adelaide stations in the Port Pirie district are generally unsatisfactory.

"In order that you might be aware of the situation, I would like to explain that with the introduction of television services progressively throughout the Commonwealth, it is not unusual for programs from television stations to be received at points beyond the areas which they are intended to serve as in the case of Port Pirie.

"In an endeavour to overcome difficulties brought about by inadequate signal strength available in the area from the Adelaide television transmitters, viewers who desire to undertake such reception may have to install elaborate aerial systems and associated amplifiers as part of their complete television receiving installations.

"Unfortunately, television receiving equipment operated under such conditions is most susceptible to all forms of interference which in many cases cannot be

reduced to a level which would permit satisfactory reception.

"At Port Pirie the interference now experienced arises primarily because of overloading of these sensitive receivers by transmissions from radio services operating legitimately in other parts of the radio spectrum.

"The provision of a reliable television service in Australia is being approached on the basis of providing local stations and, in line with this policy, the Australian Broadcasting Control Board is at present considering applications for a licence to establish a commercial station which will serve the Spencer Gulf North area, including Port Pirie, and which, when it commences operation, besides providing satisfactory service for viewers, will widen the scope of programs available for their selection and also render reception of Adelaide stations less necessary.

"In the meantime, however, the Department will continue to investigate any complaint of interference affecting television reception it might receive from the area.

"Viewers should clearly understand, however, that it is not always possible for the Department to ensure interference free reception of Adelaide stations.

"In view of the situation in Port Pirie, any action you could institute to publicise the position would be in the interests of Port Pirie and district viewers and would, of course, be welcomed by the Department."

This ruling will no doubt apply to the reception of television stations located outside any particular service area, whether or not the area has its own station.

Viewers in these areas will find that the amateur operators will be just as eager as their counterparts in Port Pirie to assist in combating the problem as they are to maintain their right to remain active on the air.

The Australian Amateur Service will be grateful that the P.M.G. Department have given an official ruling on the situation and, to the publishers of "The Recorder" for fearlessly defending the amateurs' case.

MOONBOUNCE AND OSCAR PROJECTS

From Roy Hart, VK2HO, a batch of information has been received dealing with moonbounce experiments and OSCAR project news. This information is being edited by George Jacobs, W3ASK, and highlights from these interesting articles will be included in next month's notes.

However, just as these notes were being completed, it was learned that the Oscar Project Group hoped to have OSCAR IV placed in orbit on December 2.

It is expected that each orbit will take three days, allowing the satellite to be in view for a period of three hours.

Signals transmitted to the satellite on 144.1MC will be relayed back on 431.8MC. It was not known at the time if frequency inversion will take place.

1965 CQ WORLD-WIDE DX CONTEST

The C.W. Section of the CQ World-Wide DX Contest for 1965 will commence at 0000 hours GMT, Saturday, November 27, and finishes at 2400 hours GMT, Sunday, November 28.

Contest activity will be in the 1.8; 3.5; 7.0; 14; 21 and 28MC amateur bands.

There will be: Single operator (a) all bands; (b) single band, multi-operator, single transmitter, and multi-operator, multi-transmitter sections.

Awards will be made to the highest scoring stations in those sections and a cup will be awarded to the highest scoring station in the world. There are also 12 special awards to be made for various sections.

*News and notes of Divisional and Club activities, submitted for inclusion in these columns, should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.

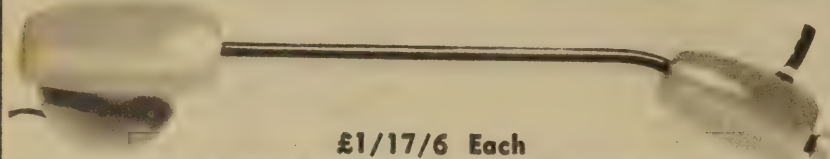
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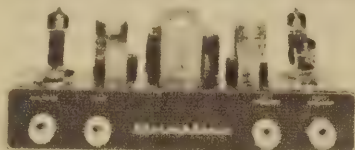
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1 meg., 100K log 7/6 each
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0.1 meg., 2,500, 10,000, 0.1 meg.,
50,000, 0.1 meg. 5/ each

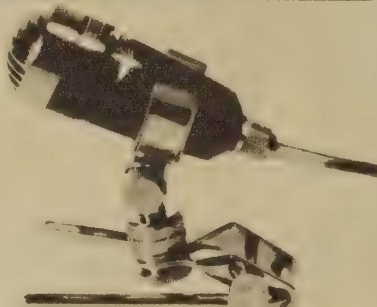
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Amplifiers 300 mil 225 a side .. £4
Silicon Diodes 210 7/6 each
SPEAKER TRANSFORMERS 3 or
15 o.h.m. 12/6
Larger size 17/6



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TU 10 3.5 watt per channel, £12.
TU11 including outlets for micro-
phone and tape recorder, £14.
TU 12.5 watt per channel, £13/10/-.
All kit sets include speakers and
every component including valves.
Pots 250K, 5/- each.
Amplifier kit set 5 watt complete £11.
Transistor ear plugs 3 for 10/
TU 13 watt per channel with TU 11
facilities £16/-/-.

TV TUNERS, 13 Channel,
New £7/10/, post 7/6
KNOBS, long shaft,
push on 12/ dozen
KNOBS, for concentric
shaft 12/ dozen
TAG strips, mixed 6/ dozen
SPEAKER TRANSFORMERS:
25,000 to 3 ohm 15/
15,000 to 3 ohm 15/
250 mixed Screws, self tappers, bolts,
nuts, etc. 10/ bag, post 2/6
Pots, 200K, 7,500 5/
OAK 4 position Switch 5/
2 position 2/6
Crystal Microphones, good quality,
ideal tape recorders, etc. .. £1/8/



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ohm £2 15 0
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Mini Cable 4 strand shielded, lots
of uses including Microphone
Cable 1/- yard
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All types £1/15/0 to £10.

All entries must be postmarked NO
LATER than January 15, 1966. Logs are
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CQ WW Contest Committee,
14 Vanderverter Avenue,
Port Washington, L.I., N.Y. 11050.

The top scoring Australian stations in
the 1964 CQ World-Wide Contest were:—

Call Sign	Band	Total Score
Phone-Single Operator.		
VK2KM	21MC	16,568
VK2APK	14MC	93,086
VK2WD	14MC	15,458
VK2AKF	14MC	12,803
VK3ATN	All	182,055
VK3TL	14MC	40,362
VK3HL	14MC	17,667
VK3XB	7MC	1,282
VK3KS	7MC	360

C.W.-Single Operator.		
VK2GW	All	323,050
VK2PV	All	58,776
VK2RA	All	2,296
VK2APK	14MC	116,982
VK3AXK	All	49,476
VK3TL	All	10,887
VK3RJ	21MC	9,612
VK3ADB	7MC	15,660
VK3XB	3.5MC	1,443
VK4SS	All	7,950
VK4EL	21MC	16,297
VK4SD	14MC	15,181
VK5TC	All	87,498
VK5WC	14MC	12,324
VK5KO	1.8MC	6
VK7SM	All	62,608

C.W.-Multi-Operator. Single Transmitter.
VK5ZP-VK5NO 914,742 points
The highest scorer for each band in
each call area will be awarded certificates.

RECIPROCAL LICENSING

The first reported Australian amateur to
take advantage of the recently inaugurated
reciprocal licensing arrangements between
Australia and the United States of America
was Joe Wall, VK3BL.

Joe was reported to be operating from
the W5 call area during early September.

W.I.A. Activities

The rules for two national contests have
been finalised by the Federal Contest Com-
mittee of the W.I.A. The Ross Hull Mem-
orial Contest will be held from December
11, 1965, until January 16, 1966, and the
John Moyle Memorial National Field Day
to be held on the weekend, February 12-13,
1966.

Changes have been made to the rules of
both these contests in line with the wishes
expressed by Divisions at the 1965 Federal
Convention.

Full details of the rules for both contests
will be included in later issues of these
notes.

NEW SOUTH WALES

Ted Whiting VK2ACD's lecture dealing
with the latest UHF equipment being in-
stalled by the Department of Civil Avia-
tion was the highlight of the September
meeting of the New South Wales Division.

The lecture was illustrated by slides show-
ing circuitry and block diagrams of the
system. When completed a system of base
and repeater stations for air traffic control
will cover a large portion of the States' air-
line routes.

Ted so capably described the equipment
that it has caused some speculation among
the VHF operators. Ted is an ardent DX
operator but, since joining D.C.A. and be-
coming associated with modern VHF/UHF
equipment, there is certainly room for con-
jecture as to which bands Ted's future
activities might lead him.

A warm round of applause indicated
members' appreciation of the lecture.

VHF AND TV GROUP

Thirty-one logs were received for the
State section of the Remembrance Day
Contest. It is anticipated the same number

or even more will be listed when the full results of the contest are published.

The place getters in the State section were:

1st Tony Mullen VK2ZCT, 2nd Dick Norman VK2ZCF, 3rd Stephan Kuhl VK2ZSK.

Response to the invitation to participate in a VHF field day to be held over the New Year Day weekend has been good. At the end of September, it was known that twenty five field locations would be manned in New South Wales. These extended from Mount Kosciusko in the south, Mount Kaputar in the North-west, Mount Canobolas in the west as well as several good locations along the coast.

VHF operators in New Zealand, Victoria, Queensland, South Australia and Northern Territory have also indicated that they will participate.

It is also expected the 432MC, 1296MC as well as 52MC and 144MC will be used by some of the field stations.

VALE

It is with very deep regret that the death of John Peell, VK2WJ, is recorded. John, for many years, was active on the VHF bands and had several firsts to his credit and was a keen mobile operator both on VHF and HF bands.

In his professional radio life he had been a ship's operator and from the time the Overseas Telecommunication Receiving Centre at Bringley was established, until his retirement due to illness, he was the station manager.

Just prior to his death John made a gift of the proceeds from the sale of his amateur radio equipment to the New South Wales Division of the W.I.A.

The deepest sympathy of his fellow amateurs is extended to his wife and relatives in their sad bereavement.

HUNTER BRANCH

The September meeting of the Hunter Branch was held as usual in Room 6 of the Clegg Building on Friday 3rd. The meeting was given over to a final discussion on the convention arrangements for the field day. This was followed by a program of films. The latter caused some anxious moments for the projectionist and audience alike when the film caught fire, but the showing was otherwise without incident.

The next meeting will be held at the same location at the Newcastle Technical College on Friday, November 5, when the first of three lectures on technical developments in the electronics industry will be delivered by a lecturer from Mullard-Australia Pty. Ltd. These lectures will continue at the December and February meetings.

The weekly news broadcast of the Hunter Branch is made each Monday evening from the official station VK2AWX. The transmissions originate at the Westlakes Radio Club, Teralba, and may be heard on 1815KC; 3595KC and 7050KC. The best frequency for local listening is the top band—1815KC, which is heard well all over the local area and is generally free from interference.

BLUE MOUNTAINS SECTION FIELD DAY

The Blue Mountains Section of the New South Wales Division of the W.I.A. will hold their annual field day at the old location—the Lawson Swimming Pool Grounds. The date, Sunday, November 21.

This year it is hoped that members of the Youth Radio Scheme and interested Boy Scouts will be able to participate in the field events and the various contestants will provide accommodation in the vehicles. The late date of the field day will ensure that the lads' school examinations will be completed before the event.

Registrations will commence at 10.00 a.m. The program is as follows:
11.15 a.m.: 144MC Sniffer Hunt on foot within the pool grounds.
12.00 p.m.: Lunch.

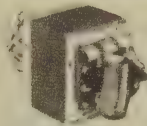
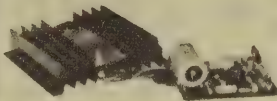
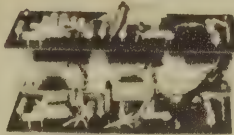
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Input control unit-wired for 5 inputs. Power supply unit will supply mono or stereo.

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Unit 8. Input Control—Stereo.	£ 5 6 0
Unit 9. Power Supply—24V or 40V.	£ 8 13 0
Unit 10. Wide Band Transistorised Tuner.	£ 17 17 6
Unit 11. Wide Band Transistorised Stereo Tuner.	£ 28 5 0

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Crystals £8/10/ each plus 12½ per cent sales tax

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PRICES ON APPLICATION.

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Amateur — from £3/-/- each plus 12½ per cent sales tax.

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56 Collins St., HOBART and
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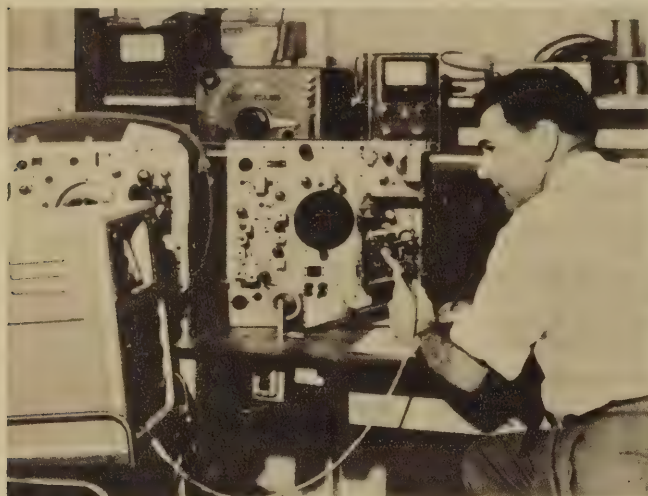
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State Offices in Adelaide, Brisbane, Hobart, Perth and Sydney.

1.00 p.m.: 144MC Hidden Transmitter Hunt.
1.30 p.m.: Bus Trip for the Ladies
2.15—2.45 p.m.: 144MC Scramble
3.00—3.30 p.m.: 7MC Scramble.
4.15 p.m.: Prize Presentation.

Registration Fee: 10/ for each member (including family.)

There will be the usual ice creams, drinks, and hot water free. Lucky numbers and lucky dips.

Make November 21 your day for a trip to the mountains—the weather should be perfect.

CENTRAL COAST SECTION

Eighteen members attended the September meeting of the Central Coast Section, held at the School of Arts Gosford on Friday evening 18th, when a short talk on mobile antennae was given by Frank Pearson VK2ACQ.

It was with regret that the resignation was announced of Perc Day who, due to ill health, has had to relinquish the office of treasurer which he has carried out so ably for the past two years. Perc also took an active part in the running of the A.O.C.P. classes. The best wishes from members for a speedy recovery have been conveyed to him.

Alex Swinton VK2AAK is now the QSL officer for the club and members are invited to avail themselves of this service.

Visitors are always welcome, and meetings are held in the School of Arts Gosford on the third Friday of each month, commencing at 8 p.m.

For information on the activities of the club, ring the president, Ern Hodgkins, VK2EH, Gosford 2-2444.

VICTORIA

The Eastern Zone Convention of the Victorian Division will be held at Traralgon on Saturday, 20th, and Sunday, November 21.

Commencing at 3 p.m. on Saturday in the Masonic Hall, Church Street, Traralgon, there will be a display of commercially built amateur band equipment. Also during the afternoon there will be a sale and swap section for members' gear.

At 6 p.m. there will be a buffet dinner to which the ladies are invited. A meeting to discuss activities within the zone will commence at 7.30 p.m., while social entertainment will be provided for the ladies.

On Sunday there will be visits to local beauty spots and a picnic lunch.

Reservations for overnight accommodation should be sent to:— Stan Baxter, Eastern Zone Secretary, 10 Chenhall Crescent, Traralgon, Victoria.

QUEENSLAND

Monthly W.I.C.E.N. exercises are being held in the Queensland Division with a good deal of success, and letters expressing interest in the scheme have been received by the organisers.

Information and maps defining zone boundaries can be obtained by writing to:— Wireless Institute Civil Emergency Co-ordinator, Box 638J, G.P.O. Brisbane.

Following discussions with Messrs A. H. MacKenzie and C. Gold, donors of the CG and GK Cup, and the division's president L. Blagbrough VK4ZGL, it has been agreed to award the trophy annually to the Queensland member scoring the highest number of points in the Remembrance Day Contest.

The trophy was originally donated in 1926, as the Best Station Award Trophy. However, changing modes and circumstances have now made the selection of the recipient virtually impossible.

Council have ratified the decision and have resolved that the first presentation be made when the results of the 1965 event are published.

Provided that the necessary bookings can be made the Annual State Convention of the division will be held over the weekend of March 26-27, 1966, at Alexandra Headlands. Bob Campbell VK4ZRC has agreed to again organise the event.

WESTERN AUSTRALIA

From the September issue of the Western Australian Division's Bulletin came news of a get-together of old-timers. The item is as follows:

"The Highway Hotel, Claremont, was the venue for a meeting of old-time amateur operators on Wednesday, August 14. The function took the form of a luncheon under the sponsorship of VK6AG; VK6WP; VK6SA; ex-VK6BO and VK6MU.

"VK6MU explained that there was a lack of official listings of amateur stations in the 20s, but one had been located for 1927 showing 26 licences, about half of whom, for one reason or another, were no more. Every effort had been made to locate old-timers of that period.

"Among those present were VK6GH, who founded the university station 6AK in the 20s. Jack Vincent ex-VK6VK who with the ex-VK6AB (late Clyde Cecil) put Kalgoorlie on the map, and R. Earl VSIAB who was chief electrical engineer of the Singapore Harbour Board. Geoff Lorden ex-VK6GL wrote from Melbourne.

"Wally Coxon VK6AG gave a resume of the foundation of the Perth Radio Club (the first in Australia) in 1907.

"The eighteen amateurs present resolved that it would be a good idea to have a get-together once in a while, and it was decided that the next time would be a night function to leave more time for an after-dinner talk. A committee was elected to draw up a plan which would set out the groundwork for such an organisation

and provide for membership qualifications, etc.

"Those present were:— VK6GM; VK6MY; VK6SA; VK6AG; VK6WP; VK6FG; Frank Goldsmith ex-VK6FG; ex-VK6VK; VK6JS; ex-VK6BO; VK6GH; VK6MU; ex-VK6HW; VK6KX; VK6WM; VK6WW and Chas. Forster, with apologies from Frank Narroway; VK6FH; VK6LJ; VK6LG; ex-VK6GL; and VK6NS."

S.W.L. AWARDS

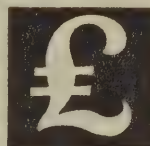
Two Short Wave Listener Awards have been announced by the Wireless Institute of Australia. Attractive Certificates will be awarded to S.W.L.'s who submit evidence of fulfilling the following requirements.

Australian S.W.L. Century Club Award

Objects:

- 1.1 This award was created in order to stimulate interest in logging DX (amateur stations) in Australia, and to give successful applicants some tangible recognition of their achievements.
- 1.2 This award, to be known as the "S.W.L. Century Club Award" will be issued to any resident Australian short wave listener who satisfies the conditions as set out.
- 1.3 A certificate of the Award will be issued to any applicant who produces proof of having logged one hundred countries, and will be endorsed, as necessary, for loggings made in respect of one type of emission.

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Fashion Drawing
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Cost Accountancy
General Bookkeeping
Salesmanship
Shorthand Typing

Retail Management
Commercial Management
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Hotel-Motel Management
Club Administration
Window Dressing
Business Letters

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Building Contracting
Carpentry, Joinery
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Roofing, Steel Square
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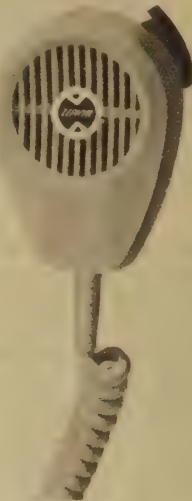
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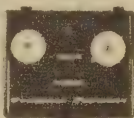
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No. 598—Complete Kit of parts, to smallest screw. £27. No. 656—Wired ready to operate, £29/10/-. Postage 10/- each. Size: 6in w. x 3in h. x 8in d. weight 6½lb.

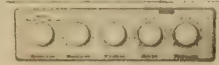
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Range 30 miles. 200 with short aerial and earth. Ear-piece only, no speaker. Wired ready to use, No. 666D. £5.
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For 5 watt amplifier with panel and knobs. Stereo do-it-yourself kit No. 616C Mono, do-it-yourself kit No. 616AC

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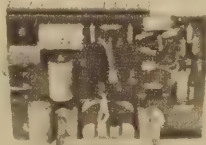
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1964 RF Transporta 7. Complete kit — No. 640: £21/15/-
Portable car radio, identical to 640 above, plus extra switch and car coil, etc. No. 642: £23/-/-.
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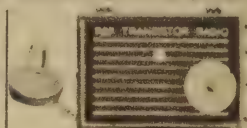
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Frequency response—30 cycles to 18 KC, 3 DB. Distortion — one half of one per cent or better. Input—125 MV, 1,000 ohms impedance. DC supply—22 volts 0.8 amps, speaker 15 ohms. Size: 5½in long x 4in high x 3in deep.

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R.C.S. RADIO PTY. LTD., 651 FOREST ROAD, BEXLEY, N.S.W. 58-3491, 58-5385.

Requirements:

- 2.1 Verifications are required from one hundred different countries as shown in the official "Australian DXCC Countries List."
- 2.2 The official countries list will be published annually in "Amateur Radio" and will be amended from time to time as required. Should a country be deleted from the list at any time, members and intending members will be credited with such country if the date of logging was before such deletion.
- 2.3 The commencing date for the award is January 1, 1946. All loggings made on or after that date may be included.

Operation:

- 3.1 Loggings must be made in the HF Band (Band 7), which extends from 3MC to 30MC, but each logging must be made of stations operating in the authorised amateur bands in Band 7.
- 3.2 Loggings may be made of any authorised type of emission for the band concerned.
- 3.3 Credit may only be claimed for the logging of stations using regularly-assigned Government call signs for the country concerned.
- 3.4 Loggings of ship or aircraft stations will not be allowed, but land-mobile stations may be claimed, provided their specific location at the time of logging is clearly shown on the verification.
- 3.5 All stations must be logged from the same call area by the applicant.

Verifications:

- 4.1 It will be necessary for the applicant to produce verifications in the form of QSL cards, or other written evidence showing that specific loggings have been made.
- 4.2 Each verification submitted must be exactly as received from the station whose signals were logged and altered or forged verifications will lead to disqualification of the applicant.
- 4.3 Each verification submitted must show the call sign, the date, and the time of the contact, type of emission and frequency band used and the location or address of the station at the time of the logging.
- 4.4 A check list must accompany every application setting out the following details:
 - 4.4.1 Applicants name and listeners number, if any, and whether a member of the W.I.A. or not;
 - 4.4.2 Detail of any special endorsement involved;
 - 4.4.3 Details of each contact as required by Rule 4.3;
 - 4.4.4 The applicant's location at the time of each logging and if portable/mobile operation is involved;
 - 4.4.5 Any relevant details of any contact about which some doubt may exist.

Applications:

- 5.1 Applications for membership shall be addressed to "S.W.L. Awards Manager," G.P.O. Box 2611W, Melbourne, Victoria, accompanied by the verifications, check list, and sufficient postage for the return of the verification and registration, if desired.
- 5.2 A nominal charge of 25c (2/6), which shall be forwarded with the application, will be made for the issue of the certificate to successful applicants who are non-members of the Wireless Institute of Australia at the time of application.
- 5.3 Successful applicants will be listed periodically in "Amateur Radio." Members of the S.W.L.C.C. wishing to have their verified totals, over and above the one hundred necessary for membership, listed, will notify these totals to the "S.W.L. Awards Manager," in writing.
- 5.4 In all cases of dispute, the decision of the S.W.L. Awards manager and two officers of the Federal Executive of the

W.I.A. in the interpretation and application of these rules shall be final and binding.

- 5.5 Notwithstanding anything to the contrary in these rules, the Federal Council of the W.I.A. reserves the right to amend these when necessary.

HEARD ALL VK CALL AREAS AWARD (H.A.-VK-C.A.)

Objects:

- 1.1 This award was created in order to stimulate interest in logging, by overseas short wave listeners, of amateur stations in the various call areas of the Commonwealth of Australia and its Territories and to give successful applicants some tangible recognition of their achievements.
- 1.2 This award, to be known as the H.A.-VK-C.A. Award, will be issued by the Wireless Institute of Australia to any short wave listener in the world who is a member of an affiliated society of the I.A.R.U. who satisfies the following conditions. No S.W.L. resident in Australia or its Territories will be eligible for this award.
- 1.3 A certificate of the award will be issued to the applicants who show proof of having logged stations in all of the Australian call areas as listed in the appendix. No endorsements are available.

Requirements:

- 2.1 Verifications are required from all the call areas of Australia and its Territories as shown in the appendix. In all, 22 verifications are necessary.
- 2.2 The commencing date of the award is January 1, 1946. All loggings made on or after this date may be included.

Operation:

- 3.1 Loggings may be made of Australian stations using any authorised frequency band or type of emission permitted to Australian amateurs.

- 3.2 Credit may only be claimed for logging stations using regularly assigned Government call signs.

- 3.3 Loggings of ship or aircraft stations in Australia or Australian Territories will not be eligible, but land-mobile stations may be claimed, provided their specific location at the time of logging is clearly shown on the verification.

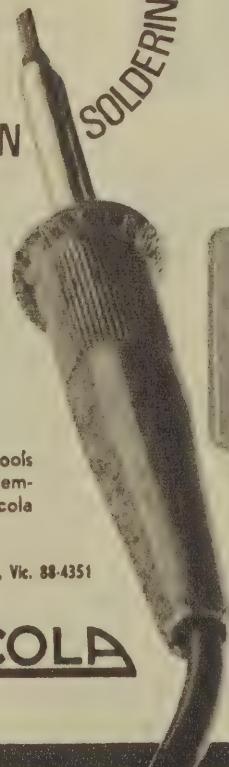
Verifications:

- 4.1 It will be necessary for the applicant to produce verifications in the form of QSL cards or other written evidence showing that specific loggings have been made.
- 4.2 Each verification submitted must be exactly as received from the station logged, and altered or forged verifications will lead to the disallowance of those items and may lead to disqualification of the applicant.
- 4.3 Each verification submitted must show the date and time of transmission, type of emission and frequency band used and the location or address of the station at the time of logging.
- 4.4 A check list must accompany every application setting out the following details:
 - 4.4.1 Applicant's name, S.W.L. number, if any, and address;
 - 4.4.2 Name of affiliated society (see Rule 1.2);
 - 4.4.3 Details of each logging as required by Rule 4.3.

Applications:

- 5.1 Applications for membership shall be addressed to the "S.W.L. Awards Manager, G.P.O. Box 2611W, Melbourne, Victoria, Australia," accompanied by the verifications and the check list (Rule 4.4). Sufficient international reply coupons (I.R.C.) must be enclosed to cover return postage of the verifications to the applicant.
- 5.2 Where a reciprocal agreement exists

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Modern Design, 33 Micro Amp
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30,000 Ohms per Volt D.C.

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Ohms per volt.

AC Voltages: 0-3-12-30-120-300-
600-1,200 V at 13,000 Ohms per
volt.

DC Current: 0-0.06-6-60-600 mA,
0-12 A.

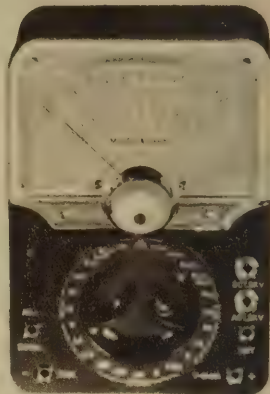
Resistance: 0-60K-6M-60M (350,
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Decibels: minus 20 to plus 57
dB (0 dB equals 1 mW. 600
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Audio Out: Capacitor in series
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Short Test: Internal buzzer.

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Price £15/10/-

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Batteries: 1 (1.5V), 1 (15V).
Size: 3 5-16" x 6 5-16" x 2 1/2"
Weight: 1.4lb approx.

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Model RH-10



RANGES:

DC Voltages: 0-10-50-500-1,000
V at 2,000 Ohms V.

AC Voltages: 0-10-50-500-1,000 V
at 2,000 Ohms V.

DC Current: 0-500uA 0-500 mA.

Resistance: 0-10K-1 Meg: 60
ohms, 6 Kohms at centre
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Capacitance: 250uuF to 1uF, in
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Decibels: -20 to plus 36db, two
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Output: 0-1,000 V in four ranges.

Size: 5in x 3 1/2in x 1 1/2in.
Weight: 13oz approx.

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Postage 5/- to 10/- extra.

Model RH-5

* High sensitivity-20,000 Ohms/
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* 3in Meter.

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DC Voltages: 0-10-50-250-500-
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AC Voltages: 0-10-50-250-500-
1000 V (10,000 Ohms/V).

DC Current: 0-50uA, 0-5-50-
500mA.

Resistance: 0-10K, 0-100K,
0-1Meg, 0-10Meg.

(62 Ohms, 620 Ohms, 6.2K,
62K at centre scale).

Capacitance: 0.0001uF-0.005uF,
0.05uF-1uF.

Decibels: minus 20db to plus
36db in 2 ranges.

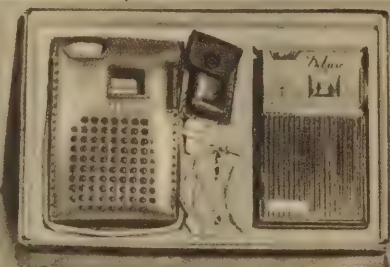
Dimensions: (3 1/2" x 5 1/2" x 1 1/2").

Weight: 15oz approx.
Complete with internal battery,
testing leads with prods.



Price £9/-/-

Postage 5/- to 10/- extra.



SCOOP PURCHASE

6 Transistor de luxe model Radio
made by International. Complete with
leather carrying bag and earphone,
etc. Size 4 1/2in x 2 1/2in.

£10/10/- reduced from £15/15/-

Plus postage and packing 7/6.



Actual Size

"KEY LITE" 39/11

with fob keyring, attractive plastic
case. Simply squeeze. Illuminates
car and house locks, etc.

40/- Posted anywhere

NEW FROM GERMANY



THE OXFORD CORDLESS ELECTRIC RAZOR

Battery Operated

Twin blades
rotary cutting
head, spare
batteries 1/6.
Size 5in x 1 1/2in.

£3/19/6

SPECIAL OFFER
ALL TRANSISTOR RADIO POCKET SIZE
£5/19/6 Postage 5/-

RADIO HOUSE PTY. LTD.

306-308 PITT ST., SYDNEY. Also at 760 George St. and 6 Royal Arcade. (26-2817)

W.I.A. YOUTH RADIO SCHEME

The Federal Co-ordinator of the Wireless Institute of Australia Youth Radio Scheme, Rex Black VK2YA, reports that excellent progress is being maintained in clubs throughout the Commonwealth. In New South Wales there are now 35 clubs registered with the scheme, catering for more than 1,000 students.

HOLIDAY CAMP

During the Christmas vacation, the Inter-School Christian Fellowship will conduct "Camp Technology," a holiday for school-boys interested in electronics and photography.

The Grange, a large and comfortable holiday house at Mount Victoria in the Blue Mountains, west of Sydney, which can accommodate 80 persons, will be equipped with modern instruments and components to cater for a large range of construction projects in the fields of electronics and photography.

Graded projects and workshop sessions will be directed by a team of competent instructors. The electronics course will cover such aspects as valve and transistor experiments, radio, telephony, short wave communications, audio and electronic switching. The photography sections dealt with will include taking photographs, developing, printing and enlarging techniques.

"Camp Technology" is a member club of the Youth Radio Scheme and the nine days will include instruction and examination in Elementary, Junior and Intermediate Certificate grades.

Schoolboys in the second form grade to 5th year are eligible to apply.

The dates for the Camp are from December 28, 1965, to January 6, 1966, and the cost will be £9/10/.

Application forms can be obtained from: Camp Technology, c/o 68 Bancroft Avenue, Roseville, New South Wales.

WESTLAKES RADIO CLUB

Ten boys from the Westlakes Radio Club made a most interesting visit to Sydney during the September vacation when a one-day visit was made to the A.B.C. studios, in Forbes Street, Sydney and the A.W.V. valve and transistor factory at Rydalmere.

Mr Stan Dogger of the A.B.C. staff conducted the boys around the broadcasting studios during the morning. Among the sections visited were the switching and recording departments, the studios and control rooms, and the tape and record library. One most instructive quarter-hour was spent with Bob Moore while he conducted a recorded music program on the Third Network.

In the afternoon the boys were shown around the A.W.V. factory by two of the staff who took great interest in the group and introduced them to the intricacies of valve and transistor manufacture. Afternoon tea was served by the Valve Company and each boy went away with a wallet of information about the processes.

Most of the boys handed in their entries in the AWA-AWV "Multiflash" construction project. This competition was promoted by the company at the science exhibition held recently in Sydney, when circuit details of a flashing light, together with suitable transistors, were distributed to lads interested in entering a construction contest.

These two most informative industrial visits introduced technically minded boys to some of the new techniques and processes and gave them an insight to the career opportunities in the electronics industry.

The club and the Youth Radio Scheme are indebted to Mr Stan Dogger of the ABC and Mr Shonrock of A.W.V. for their kind invitations.

VICTORIA

Two very handsome donations have been made to the Youth Radio Scheme in Victoria. One is a transistor kit set valued at £7 from Mr K. Lane of Transistor Kits, 69 Church Street, Brighton, Victoria.

The kit is all Australian made and is complete with components, hardware, tools and instruction manual.

This kit will be presented to the Y.R.S. member in Victoria who gains the highest marks in the Elementary Certificate Examinations for 1965.

The other was a gift of six soldering irons from Mr Royston, of the Adcola Manufacturing Company, 12 Churchill Street, Mont Albert, Victoria.

These will be distributed to each State to be used as prizes in conjunction with the certificate scheme. Details as to the grade to which this will apply will be given in later news bulletins.

The organisers of the Y.R.S. are grateful to these and other companies and organisations who have so generously supported the scheme and in doing so have enabled students to be presented with some tangible reward for their achievements.

It has been decided to award the £3 open order for books donated by the Technical Book and Magazine Company, Melbourne, to the Victorian Y.R.S. member who gains the highest marks in the Junior Certificate examinations for 1965.

between the W.I.A. and the applicant's society, the appointed officer of that society may carry out the check, and if correct, may forward a written application for the award on behalf of the applicant. The list (Rule 4.4) must also be forwarded.

5.3 Applications will be examined by the S.W.L. awards manager, who will arrange for the award to be forwarded either direct, or through the applicant's society is required.

5.4 In all cases of dispute, the decision of the S.W.L. awards manager and two officers of the Federal Executive of the W.I.A. in the interpretation and application of these rules shall be final and binding.

5.5 Notwithstanding anything to the contrary in these rules, the Federal Council of the W.I.A. reserves the right to amend them as necessary.

APPENDIX

Territory	Call Area	QSLs required
Australian Antarctic	VK0	1
Heard Island		
Macquarie Island		

Australian Capital Territory	VK1	1
State of New South Wales	VK2	3
Lord Howe Island		
State of Victoria	VK3	3
State of Queensland	VK4	3
Thursday Island		
Willis Island		
State of South Australia	VK5	3
State of Western Australia	VK6	3
State of Tasmania	VK7	3
Flinders Island		
King Island		
Northern Territory	VK8	1
Admiralty Islands	VK9	1
Bougainville Island		
Christmas Island		
Cocos Island		
Nauru		
New Britain		
New Guinea		
New Ireland		
Norfolk Island		
Papua Territory		

Note:—

In areas above, where more than one confirmation is required, contacts may be made with any or all of the territories listed under each call sign.

TRANSISTOR KITS CHRISTMAS BONUS

**Make any of these
EXCITING PROJECTS
for ½ the usual price**

Just released for Christmas to add to your holiday fun.

Complete step-by-step instructions, including circuit, wiring diagram and construction diagrams free with each project.

ALL THESE PROJECTS ARE BENCH TESTED AND GUARANTEED TO WORK.

Broadcast Tuner (Superhet). (Instructions FREE). All the parts you need selected from the list below, plus resistors, capacitors, 9V battery and sundries.

Without cabinet . . . only £7/19/5

With Cabinet . . . only £9/9/6

Amplifiers (Instructions FREE). All the parts you need selected from the list below, plus resistors, capacitors, 9V battery and sundries.

3 transistor only . . . £6/19/6

4 transistor only (push-pull) . . . £7/18/6

6 Transistor Portable (Instructions FREE). All the parts you need selected from the list below, plus resistors, capacitors, 9V battery and sundries, only £14/10/.

House Telephone (Instructions FREE). All the parts you need selected from the list below, plus resistors, capacitors, 9V battery and sundries, only £8/19/6.

Flashing Lights (Instructions FREE). All the parts you need selected from the list below, plus resistors, capacitors, special circuit board, fabricated perspex mounting strip, 9V battery and sundries, only £5/19/6.

Alarms (Instructions FREE). All the parts you need selected from the list below plus resistors, capacitors, 9V battery, Relay and sundries.

Light activated (c w light sensitive device) . . . £4/15/6

Sound activated . . . £6/19/6

Switches (Instructions FREE). All the parts you need selected from the list below plus resistors, capacitors, 9V battery, Relay and sundries.

Light activated (c w light sensitive device) . . . £4/15/6

Sound activated . . . £6/19/6

Basic List of Parts Supplied in the above projects (other necessary parts supplied at special trade kit prices):

Audio Parts

Speaker, 8 ohm, 2.25in dia. . . 22/6

Output Transformer (480 ohm to 8 ohm) matched to speaker) . . 15/6

Miniature coupling transformer, 8K: 3K . . . 13/6

5K Potentiometer c w switch and knobs . . . 9/

R.F. Parts

Oscillator coil, 360 mH . . . 9/

Two gang miniature capacitor c w knob dial . . . 20/8

Febrite High Q Aerial Coil (loopstick aerial) . . . 7/6

3 IF transformers . . . 34/

General

6 transistors and 1 diode (1 x 2N412; 2 x 2N410; 3 x 2N408) or equivalents . . . 79/6

Printed circuit board . . . 12/

Cabinet . . . 20/

Carrying Case 6/

Earpiece . . . 7/

30/ complete

ALL THESE PARTS ARE GUARANTEED AND AVAILABLE SEPARATELY — PRICES INCLUDE SALES TAX AND DELIVERY CHARGES.

Order to

TRANSISTOR KITS

69a Church Street, Brighton, S.S., Vic.
Phone 92-3159

A.

AMPLIFICATION

C.

COMMUNICATION

RADIO



E.

ELECTRONICS

636 KING STREET, NEWTOWN—51-7008

136 VICTORIA ROAD, MARRICKVILLE — 51-3845

B.S.R.
4 TRACK DECK
£17/15/-

2 Track, 3 Speed.
£17/15/-

4 Track, 3 Speed. Mono or Stereo.
£22/12/6

4-TRACK, 3-SPEED.
3 HEADS.
£24/15/0

BRADOMATIC HEADS
Latest 1/2 Track. HI FL.
£4/15/- Pair

THE NEW COLLARO TAPE DECK

Takes 7in spool.
3 speeds 1 1/4, 3 3/4, 7 1/2 i.p.s.
2 track £22.
4 track £24.
Write for particulars.

TRANSISTOR POWER SUPPLIES

12v. D.C. Input. 300v. 150Ma.
Output plus 150v. Output.
£11/17/6

12v. D.C. Input. 400v. 150Ma.
Output plus 200v. Output.
£14/17/6

VARY. A.C.S.

240-270V 50 cycle 5 amp.
Provide infinitely variable AC voltage.
£14/15/-
2 1/2 Amp as above
£11/15/-

PLAYMASTER 106 AND 107



Feb. and March R. TV & H.

106

WIRED AND TESTED, £42

107

WIRED AND TESTED, £39/10/-

ELECTRIC GUITAR

Pickup Units £4 7 6
Accordion Pickup Units £4 7 6
Harmonica Pickup Units 19 6
Post., N.S.W., 4/6; Interstate, 7/6.

SPEAKER VENTED ENCLOSURES

With 8in Twin Cone Speakers
Fitted, £9/10/- Each
Vented Enclosures for 12in Speakers.
5 1/2 c. ft. £11/15/-

Transistor-Ignition HI-SPARK

Simple installation.
38 K.V. output.
Complete. Tested.
Negative earth.
£16/15/0

Positive earth.
£20/15/0

State voltage and polarity.
Post: N.S.W. 7/6; Interstate 12/6.

CITIZENS BAND

27.240 Meg Fonet 102B
10 Transistor Transceivers.
Hi-Power. 240 MW.
Range to 10 miles.
£27/10/- each

BELCON

1 watt. 15 transistor, with squelch
provision for two channels.
Range to 60 miles under
ideal conditions.

£40 each

INTER. COM. UNITS

2 Station Transistorised

£5/15/-

4 Station including Master
£10/2/6



New Telephone Amplifier

Transistorised.

£5/15/-

Post 3/6.

T.V. TUNERS

New 10-channel Tuners.

£7/10/-

Post 7/6.

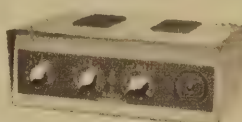
LATEST 4-SPEED PLAYERS

240V A.C. Mono £5 15 0
240V A.C. Stereo 8 10 0
Battery Mono 9 15 0
Battery Stereo 10 15 0
Battery Mono 45 r.p.m.
In Cabinet 4 12 6
Post. N.S.W. 7/6, Interstate 12/6.

Send for full details on
Radiogram Chassis, TV and
Amplifiers.

AMPLIFIERS

Public Address Range
240V-AC



MINIATURE P.A. AMPLIFIER.
15 WATTS OUTPUT.

Multimach Ferguson O.P. trans-
former input for crystal mike and
pick-up with electronic mixing. P.P.
EL84 output. £17/15/-

30 Watt. As above EL34 P.P. £23/15/-

40 Watt. As above EL34 P.P. £27/15/-

60 Watt. As above EL34 P.P. £42/15/-

100 Watt. As above KT88 P.P. £63/17/6

LINE OR VOICE COIL TRANSFORMERS.

MULLARD HI-FI RANGE.

5/10 with pre amp base and treble
boost. Ultra Linear output £21/15/-
5/20. As above £32/15/-

BATTERY-AC OPERATION

6 valve 6v plus 240v-10 watt £27/15/-

7 Valve 12v plus 240v-12 watt £29/17/6

7 Valve 12v plus 240v-28 watt £35/17/6

TRANSISTOR P.A. AMPLIFIER C.A.-512



12VDC Operation
Output 20 watts
Current consumption at max. output.
2.2 amps.

Input. High imp. mic. Also

600 ohms and tape.

Independent gain controls.

Output: Imp. 4-8-16 ohms.

Freq. Response:

200 cps—6000 cps

Dimensions 2 1/2 x 6 1/4 x 8 1/2 in.

Complete with instruction book
with circuit. All plugs.

PRICE £28/15/-

DYNAMIC MICROPHONES



DM-391 Hi-Imp £1 15 0

DM-175 Hi-Imp £2 7 6

DMS-3 Hi-Imp £2 15 0

DM-305, 600 ohms or
Hi-Imp. Suitable

stand mounting £4 17 6

DM-304, Dynamic

Cardioid, 50 ohms

or Hi-Imp. Suitable

stand mounting £7 17 6

CM-10 Crystal Hi-Imp

Suit. stand mount. £2 10 0

Post N.S.W. 2/6; Interstate 3/6.

WIDE RANGE LIGHTWEIGHT STEREO PICK-UPS



Ceramic Units, Sapphire
Styl £3 10 0
Diamond Styl £5 5 0
Universal Ceramic Stereo
Cartridge, Sapphire.
Styl £1 9 6
Diamond Styl £3 5 0

NEW WIDE RANGE SPEAKERS

15 ohm. Twin Cone
8in 3 10 0
12in 3 19 6
5in 2 5 0
5in Tweeter 1 17 6
3in Single Tweeter 1 7 6
12in Heavy Duty 20 watt £7/15/-

P.A. REFLEX HORNS

WITH UNITS

5 Watt 8 ohm 7 5 0
10 Watt 8 ohm 13 5 0
35 Watt 15 ohm 18 0 0
N.B.: As these are American ratings,
divide the wattage by 2.

STEREO RECORD CHANGERS

1965 model. 4-speed.

£10/15/-

De Luxe Model.

Fully machined and balanced.
Heavyweight turntable. Ceramic cart-
ridge.

£13/15/-

Post. N.S.W. 12/6, Interstate 17/6.



STEREOPHONIC HI-FI HEADPHONES

With padded earpieces

SPECIFICATION

Frequency Response 25—17000 cps.

Nominal Power 1 watt.

V.C. Imp. 8 ohms each channel.

£3/17/6 Post 5/.

PHILIPS DISC JOCKEY

4-Speed Players.

6V. D.C. OPERATION.

MONAURAL CRYSTAL HEAD

£4/17/6

STEREO.

£5/17/6

Post. N.S.W. 7/6, Interstate, 12/6.

MORSE KEYS

New lightweight, fully adjustable units

9/6

As above with buzzer.

Complete Morse practice set.

16/6

A.

AMPLIFICATION

C.

COMMUNICATION



E.

ELECTRONICS

RADIO

136 VICTORIA ROAD, MARRICKVILLE, SYDNEY,
AND 636 KING STREET, NEWTOWN—51-7008**K**
20
CT330**K**
20
CT500**220S 4000 O.P.V.**D.C. Volts 5, 25, 125, 500, 2500
A.C. Volts 10, 50, 250, 1000.
Current. 250uA, 250mA.
Resistance 0-10K, 0.1 Meg.**£3/19/6 Post 5/-****C.T.330 20K.OPV**D.C. Volts, .6, 6, 30, 120, 600, 1200
1000, 6000 A.C. Volts, 6, 30, 120,
600, 1200, D.C. Current, .06-6, 60,
600mA. Resistance, 6K, 600K, 6meg.
60meg. D.B. minus 20 to plus 62
5 Ranges. Specially suitable for
transistor use. **£7/19/6 Post 5/-****C.T.500 20K.OPV**D.C. Volts, 2.5, 10, 50, 250, 500
1000, A.C. Volts, 10, 50, 250, 500
1000, D.C. Current, .05, 5.50
500mA. Resistance, 12K, 120K,
1.2meg., 12meg. D.B. minus 20 to
plus 62.**£6/12/6 Post 5/-****S.E.550 100K.OPV**D.C. Volts, .5, 2.5, 10, 50, 250, 500,
1000, A.C. Volts, 2.5, 10, 50, 250
1000 D.C. Current, 10uA, 2.5, 25,
250mA, 10 amps. Resistance, 2K
200K, 2M, 20M, D.B. minus 20 to
plus 62.**£10/7/6 Post, 7/6.****P.T.34 1000.OPV**D.C. Volts, 0, 10, 50, 250, 500,
1,000.
A.C. Volts, 0, 10, 50, 250, 500,
1,000.**M.A. 1-100-500 RESISTANCE.****£2/12/6 Post 5/-****200H. 20K.OPV**D.C. Volts, 5, 25, 50, 250, 500,
2500, A.C. Volts, 10, 50, 100, 500,
1000, D.C. Current, 50uA, 2.5,
250mA. Resistance, 6K, 600K.
Capacitance, 2 D.B. Ranges.**£5/5/- Post, 5/-****ALL PRICES NET, INC. S./TAX.****V.T.V.M.**27 Ranges A.C. Powered.
D.C.V. 0, 1.5, 5, 15, 50, 150, 500,
1,500.
A.C.V. 0, 1.5, 5, 15, 50, 150, 500,
1,500 R.M.S.
A.C.V. P. to P. 0, 1.4, 4, 14, 40,
140, 400, 1,400, 4,000.
Resistance 1 ohm to 1,000 megohm.
D.B. — 10 D.B. to + 65 D.B.**£21/5/-****Post 10/-**H.V. Probe to 30 KV, £4/2/6.
T.M.K. Units, £26/15/-

TEST EQUIPMENT



WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth. Push-pull vertical and horizontal
Amplifiers. 8 position, high sensitivity vertical Amplifier.
Frequency Compensated on all positions. Calibrated .02
to 600 volt. Hard-time base, 20 cycles to 75K. Latest
American R.C.A. circuitry. Complete with probe.**3-inch £49/17/6; 5-inch £55/15/-**

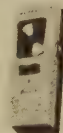
STEREO TAPE AMPLIFIER

Tape. Amplifier. Complete. Stereo Tape. Amplifier. 3 watts per channel.
KIT SET -- £80 WIRED & TESTED £90
To suit Brenel, BSR, Collaro or Truvox 3-head decks. Decks avail-
able if required.**12 watts per channel. Equal to 101 amplifier. Wired and tested. Only
£100**

LEADER MODEL

**LDM-810 G.D.O.**Frequency Range
2-250 mcs with 6 plug in coils.
Calibration Accuracy.
plus-minus 2%Internal mod. 1kc approx.
Tube 6CW4 (Nuvistor)
Operation 240VAC 50 cps.
Size 2 3/4in x 5 1/2in x 3 1/4in.
Weight 2.2lb.**PRICE £19/15/-**

TE-18

LA FAYETTE G.D.O.Frequency 360KC-220Mcs
in 8 Bands with plugs in coils.
The instrument is equipped with
0-500u.a. meter — sensitivity control
—osc/diode switch—Instruction Book
with circuit.

Operation 240VAC .50 cps.

PRICE £19/15/-

Post N.S.W. 5/- Interstate 7/6.

PANEL METERS

**EDGE TYPE**1 mA. Scaled. S. Meter. Stereo
Balance. Tuning. **£1/5/-****2" 3" 4" PLASTIC**

COVERED PANEL UNITS

Latest P series 3/4in Barrel
50 mA. 200 mA. 1mA. 10 mA
500mA. 1 Amp, 10 Amp. 15V.
500V. **From £1/10/-**

T.E. 20 RF SIGNAL GENERATOR

Freq. 120KC-260MCS in 6 bands.
Output (RF)—High 100,000uV max.
Low 100uV max.
Output (Audio)—400 cps approx. 8V.
Modulation — 400 cps internal.
Operation — 240V A.C.
Dimensions 7in x 10 1/2in x 5 1/2in.
Weight — 9lb.Complete with Instruction Book
circuit.**£13/5/-**

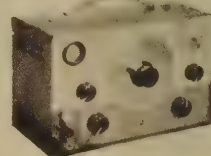
Post N.S.W. 7/6; Interstate 12/6.

LEADER SIGNAL GENERATOR LSG 11

240v A.C. Powered.
6 Band, 120 Kc to 390 Megs.
Provision for Crystal.
An Ideal TV Marker Generator.**£14/15/-**

Post. N.S.W. 7/6, Interstate 12/6.

SIGNAL INJECTOR

Transistorised. Fountain Pen sized
Unit for Signal Tracer in Radio.
TV and Amplifier Service.**£2/7/6****POST 2/6.**

T.E.46 RESISTANCE- CAPACITANCE

Bridge and Analyser
Capacity 20 pfd to 2,000 mfd.
Resistance 2 ohm to 200 megs.
Also tests power, factor, leakage,
impedance, transformer ratio, insula-
tion resistance
to 200 megs. at 600V.
Indications by eye and meter**£25/19/6**

T.E.22 AUDIO GENERATOR

Sine and Square Wave,
20 Cycles to 200 KC. 4 Bands.
Frequency response plus/minus
1.5 D.B.
60 Cycles to 150 K.C.
Output impedance 5,000 ohm.
Output volts. 0 to 7.**£22/2/6**

VALVE TESTER

Tests all valves, diodes, rectifiers,
checking filaments, shorts. Merit on
direct reading. Good-bad meter.
Complete with tube chart.**£13/7/6**

Post. N.S.W. 7/6, Interstate 12/6.



LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

SUVA ADDS FOUR NEW CHANNELS

Four new channels are soon to be put into operation by the Fiji Broadcasting Commission, Suva, in multi-language transmissions, using the 49 and 75M bands.

THE expansion plans of the Fiji Broadcasting Commission have been announced and these included a 500W transmitter for use on 5980KC. This station, VRH6 is on the air with the Sunday morning program of FBC, which is at 1800GMT onwards on Saturday. Regular daily transmissions in three languages on VRH6 are planned, and VRH7 using 6005KC will also be brought into service. These transmissions will be during the daylight hours in Suva, and the night transmission from 0600 onwards will be carried on VRH12 on 3935 and VRH13, 3980KC. VRH6 and VRH12 transmissions will be in English and VRH7 and VRH13 in vernacular. Plans are at present also being prepared to expand the studio control equipment at Broadcasting House, so that the announcer will control the complete day's program. The completion of this work will make it possible to run three simultaneous programs.

On the present transmission schedule VRH8 3230KC, 10KW, English, operates 1800-2330, 0400-1030; VRH9, 3284, 10KW, vernacular, 1800-2100, 0400-1030; VRH4, 4756, 10KW, English, 2330-0345, and VRH5, 4785, 10KW, vernacular, 2100-0400.

The new schedule will use VRH6, 5980KC, and VRH12, 3935KC for English. VRH12 will operate 1800-2330 and 0400-1030, while VRH6, 5980KC, will operate 2330-0345. The vernacular will be on VRH7, 6005KC, 2100-0400, and on VRH13, 3980KC, 1800-2100, 0400-1030, with all transmissions extended to 1100 on Saturday.

ENGLISH FROM GHANA

Radio Ghana, with its new high powered transmitters, six of 250KW and six of 10KW, is now operating on a new schedule using English, French, Portuguese, Hausa, Arabic, Swahili and Bambara.

The English transmissions, from Accra, are as follows:

To North America and Caribbean.

0330-0430GMT on 6110KC; 2000-2100, 11800; 2000-2100, 9760.

To South Africa, Central Africa and Australasia.

0430-0515, 9760; 0600-0645, 9760; 1500-1545, 17910; 1500-1545, 21545.

To Ethiopia, Somali, Sudan, India, Pakistan, Japan, China and Far East.

0300-0345, 6130; 0430-0515, 9545; 1330-1430, 17910; 1815-1900, 15285.

To West Africa.

0530-0730, 3240; 1500-2015, 6130; 1945-2215, 3240.

To Europe.

0645-0730, 9545; 2045-2215, 9545.

To East Africa.

0300-0345, 6070; 1330-1430, 17910; 1500-1545, 21720; 1645-1740, 15285; 1815-1900, 15285.

This information accompanied a verification from the station, which also included the new Radio Ghana verification card. The station gives the address as the Ghana Broadcasting Corporation, P.O. Box 1633,

Accra, Ghana, and verification is issued by the Director of Broadcasting.

SOMALI USING 4970KC

The Radio Somali Republic transmissions on 4970KC, with English from 1800 to 1830 and Italian from 1830, has been reported by Bob Padula of Melbourne. The station has been heard at excellent level, indicating that the new 10KW transmitter which was being prepared is now on the air. The station operates from studios at Mogadiscio, and for some years we have been hearing them at poor level in the 41M band. The new frequency and better signal level indicates that the station has embarked on foreign transmissions, and this should be a new country for most of our short-wave listeners. The Somali Republic is made up of the former Italian and British Somali colonies.

1966 CONVENTION

The 1966 convention of the New Zealand Radio DX League to be held near Wellington on the weekend, February 12, 13, promises to be one of the biggest gathering of DXers in the southern hemisphere. The Convention 66 has been organised by the Wellington-Hutt Branch of the League and members from all over New Zealand, and possibly from Australia, will be present.

The itinerary includes visits to the N.Z. B.C. Broadcasting House in Wellington, and DX-ing at a selected point a few miles from Wellington City. In addition, the fellowship afforded by meeting many listeners who are only names in the DX field, always adds to the enjoyment of such conventions. The Dunedin convention some five years ago, with 46 present, has been the biggest assembly of listeners so far. Anyone wishing for further information on the Wellington gathering should write to: Convention 66, P.O. Box 3700, Wellington, N.Z.

ENGLISH NEWS BULLETINS FROM PARIS

The latest schedule of the English news sessions from Paris, France, over ORTF shows an increase in the sessions, and also the use of the Brazzaville station to relay the programs for better reception in Africa. Transmission of news in English and the frequencies are as follows:

GMT	KC
0515-0530	11845, 9700, 15445.
0615-0630	11725 9730, 5970, 4795, 3232.
1020-1035	15130, 21580.
1100-1115	15445, 11970.
1300-1330	21580, 21500, 17720, 11845.
1830-1845	11845, 15130.
1915-1930	15190, 11930, 9730, 7105, 5970 3232.

The transmissions are all to Africa, except at 1300GMT when the signal is beamed to the Far East. The frequencies 9730, 5970, 4795 and 3232KC are Brazzaville.

WORLD SET DISTRIBUTION

The United States Information Agency has released its survey of radio receivers in use in the world last year, and this showed

514M receivers in operation, an increase of 18 million receivers on the previous year. The survey, which covered 162 countries and possessions, shows the United States well in front with some 228M. Second is the U.S.S.R. 35M., Japan 33M., United Kingdom 25M., West Germany 20M., France 17M., Italy 10M., Canada 10M., Brazil 8M., Spain 8M., and Australia was placed 11th with 7,482,000. New Zealand has just over 1M. receivers in use.

MALDIVE ISLANDS RADIO

The recently independent Maldivé Islands now has its own broadcasting service which operates from its capital, Male. The station, which has nearly completed its studio facilities, is using a 15KW short-wave transmitter. When completed it should give better quality reception than at present as they are using temporary studios, according to Radio Maldivé.

Operating schedule of Male Sinco Radio on Male Island is on 0130-0400 on 7150KC; 0700-0930 on 9552, and 1230-1730 on 3222. The station has news in English at 0300, 0900 and 1700GMT, the rest of the broadcasts are in Japanese, Hindi, Tamil and Sinhalese.

SABC USING 250KW OUTLET

Last month saw the opening of the first 250KW transmitter of the South African Broadcasting Corporation, Johannesburg, for use in its Africa Service. Plans recently announced show that Europe will be the target area when all four 250KW transmitters are installed. The 250KW unit now in service will be followed by a second one in March, 1966, when one daily broadcast in English to Europe will be commenced. When all four 250KW transmitters are installed by December, 1966, a full service to Europe in English, German, French, Portuguese, Dutch and Spanish will be operated.

Over the present 20KW transmitters the Africa service is now on the air, 0300-0400 on 6150 7270; 1000-1300, 15220 17805; 1300-1655 on 11900 15220; 1655-1800, 9525 and 11900; and 1800-2115 on 7270 and 9525KC. On Sunday the transmission opens at 1100GMT.

AUSTRIAN RADIO

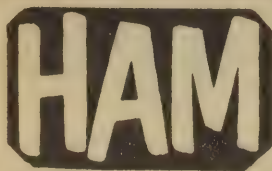
The present program schedule of Radio Austria in Vienna, shows the transmissions on the air as follows:

To Europe		KC
GMT		
0430-2300		6000
0600-1900		7245
0900-1700		9770
0900-1100	1400-1700	11785
Middle East		
0600-0900		15410
1100-1400		11785
1700-1900		9610
To North America		
2300-0430		6155
2200-0400		9770
2200-2300	Sat., Sun., Mon.	6155
India, Indonesia		
0500-0700		17805
1300-1500	Mon., Wed., Fri.	17800
To Australia, New Zealand		
0900-1100	Mon., Wed., Fri.	17810
To Japan		
1100-1300	Mon., Wed., Fri.	11725

SWISS SCHEDULE CHANGES

The recent changes in the Berne transmissions include the reintroduction of the summer service for New Zealand and Australia, which is for our evening reception and which has, in the winter months, been replaced by a morning transmission for this area.

The North American service from 0415-



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5A MELVILLE STREET, HAWTHORN, VICTORIA

Phone 86-6465

ESTABLISHED 1947

COAXIAL CABLES

UR67 50 ohm 3/16in diam. coaxial cable 1/6 yd.
or 25/ per 27yds roll.
UR43 50 ohm 3/16in diam. coaxial cable 15/
per 35ft roll.
UR71 72 ohm 1/4in diam. coaxial cable 1/6 yd
or 21 per 25yds roll.
51 OHM RG 8U 3.8 diam. BRAND NEW,
1/9 yard up to 500 yard lengths.
ALL ABOVE CABLES ARE IN AS NEW
CONDITION.

BATTERY CHARGERS

DUAL COMPLETE WITH METER IN METAL
HAMMERTONE CASE

6 volt 4 amp 12 volt 6 amp
12 volt 4 amp 6 volt 6 amp
£17/17/6 £10/17/6

IF's Q PLUS

IF 14-15 S and. Gen. Pur. 1900 K/c ... 12/-
IF34 10.7 M/c Wide Band (FM No. 1) 17/6
IF35 10.7 M/c Wide Band (FM No. 2) 17/6
IF36 10.7 M/c Ratio Detector ... 17/6

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6 OR 12 VOLT
POSITIVE EARTH ... £26
NEGATIVE EARTH ... £25

MICROPHONES

CRYSTAL
Piezo Lapel Type with Plug ... 12/6
CM20 Hand Type with Plug ... 27/6
X43 S and Type with Plug ... 37/6
BM3 Pencil Type 100-8000 c/s. with On-Off
Switch, 6ft cable ... 50/-
BM3 Desk Stand to suit above ... 21/-
DYNAMIC
Foster DF2 Hand Type 50K ... 50/6
Foster DF2 Hand Type 50 ohm ... 45/-
Foster DF3 Pencil Type 50K ... 90/-
Foster DF3 Pencil Type 50 ohm ... 87/6
Piezo X29 Desk Type with stand, low
imp. ... 52/6

SPEAKER BOXES

Plastic Speaker Box with 4in Speaker and
Wire ... 55/-
Wooden Speaker Box with 6in x 4in Speaker
and wire ... 65/-

GRID DIP OSCILLATORS

Lafayette TE-18 G.D.O. 8 Bands, Plug in
Coils, 360 Kc-220 M/C, 240 volt £19/15/0
Leader LDM-810 G.D.O. 2-250 M/C 6 Band,
Plug-in Coils, 230 Volt ... £22/5/0

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Hozan K-83 Sizes 16, 18, 21, 25 and 30 mm.,
Complete with Taper Reamer in wooden
storage box ... 70/-

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Hozan Tapered Reamer 3mm.-14mm ... 11/-

SPEAKERS

WELL KNOWN MAKE, BRAND NEW,
BANKRUPT STOCK.

SIZE	V.C.	PRICE
2in	15 OHM	30/-
3in	15-3.5	32/6
4in	15-3.5	37/6
5in	15-3.5	40/-
6in	15-3.5	45/-
5in x 7in	15-3.5	47/6
8in	15-3.5	52/6
9in x 6in	15-3.5	55/-
12in	15-3.5	52/6

TWIN CONE SPEAKERS

5in Twin Cone 4W 15 OHM ... 45/-
8in Twin Cone 10W 15 OHM ... 77/6
12in Twin Cone 10W 15 OHM ... 100/-

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TD1 Driver 3000 OHM-2000 OHM C.T. 19/6
TD2 Driver 420 OHM C.T.-105 OHM C.T. 19/6
TO1 Output 375 OHM C.T.-3.5 OHM 500
MW 16/
TO2 Output 97 OHM C.T.-3.5 OHM 1/
Watt 18/6
TO4 Output 300 OHM C.T.-3.5 OHM 5
Watt 37/6

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12 VOLT TRANSISTORISED POWER SUPPLY

Q Plus type TPSS50/12
INPUT: 12 Volts DC.
OUTPUT: 300 and 150 volt DC 50 watts
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FREQ.: 1200 c/s approx.
As new condition.

Price £11/10/0 post extra

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A new concept in high
fidelity performance

The use of P.W.M. assures a far better transient response than is possible with other amplifiers and this adds greatly to the quality of reproduction from the speaker. Harmonic distortion is so low as to be hardly measurable let alone audible, and cross-over distortion, which can cause such marked unpleasant effects in conventional transistor amplifiers, simply cannot occur at all in the X-20. Number of transistors 12
Overall size 8 1/4in x 3 1/4in x 1in
Weight 4 1/2 ounces
Input sensitivity 1mV into 5kΩ
Total harmonic distortion less than 0.1% at 10 W

Output power into 7.5 or 8 ohm speaker

20 watts R.M.S. music power

15 watts R.M.S. continuous

Output power into 15 ohm speaker

15 watts R.M.S. music power

12 watts R.M.S. continuous

These output ratings are quoted to the standard British method of rating. Using the method usually employed in the U.S.A. these ratings would be doubled giving, for example, 40 watts music power into a 7.5 ohm speaker.

Frequency response at all power levels 20 c/s to 20 kc/s plus 1 db
Damping factor Greater than 100
Quiescent consumption about 150 mA
Supply voltage 28 to 37 volts (7.5Ω speaker)
28 to 45 volts (15Ω speaker)
Signal to noise ratio Better than 70 dB
Pulse repetition frequency 65 to 75 kc/s
Energy conversion factor at output at least 95% efficient.

A filter is built into the output of the X-20 so that it may be used with any type of resistive or inductive load of the correct impedance.

X-20 AMPLIFIER

Completely Built and Tested

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SINCLAIR X-20 AMPLIFIER

Complete Kit of Parts,
with instructions for assembly.

Price: £13/7/6 inc. tax

MULTIMETER Model 200H

20,000 ohms per v. d.c.
10,000 ohms per v. a.c.



Complete with internal
battery, testing-leads and
prods.
Price £5/12/6 inc. tax.

Specifications:

D.c. volts: 0-5,
25, 50, 250,
500, 2,500.

A.c. volts: 0-10,
50, 100, 500,
1,000.

D.c. current:
0-50 uA; 25,
250 mA.

Resistance: 0-60
K ohms; 0-6
meg.

Capacity: 0-01-
0.3 uF. (at
a.c. 5v.);
0.0001 - 0.01
uF. (at a.c.
250v.).

Decibel: Minus
22 db. plus
22 db.

Output range
0-10, 50, 100,
500, and
1,000.

Battery used:
UM3 1.5v. 1
piece.

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in.

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Sato Subminiature Bezel 6-8 volt No. 3280
complete with globe, Red or black. 4/
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Capacitors, All Popular Types.
51 or 10/ a bag.
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Ceramic and Plastic Condensers, All Popular
Types.
51 or 10/ a bag.
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4802-1 Coaxial Socket (PTFE) ... 14/8
C32-14 Coaxial Dble. ended female
Joiner (PTFE) ... 17/6
UG175U Adaptor for PL259 to suit 1/4in Cable.
2/9
C32-17 Coaxial "T" Piece suit PL1259 ... 23/3
BNC Series
UG 88 C/U Coaxial Plug (PTFE) ... 15/9
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Coaxial Plug (Suit 1/4in Cable) ... 4/
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Coaxial Socket (flush Mount) ... 3/6
Coaxial Cable Joiner (female) ... 4/

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OC74	12/6	OA211/1S10AR2	17/6
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9 Transistor 100 mW output Citizens Band,
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Talkies, Individual Speaker and Microphone.
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Model PT34.

300 uA. movement.
AC and DC voltages:
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Ohm range: 0-100-
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Size 3 3/4 x 2 1/4 x 1 1/4 inches.
Complete with leads. 57/6

0515 they will use 6120KC replacing 9655, the program also being carried on 6165 and 9535KC. The second transmission for Australia and New Zealand 0830-1000 is to be on 15255KC. The first transmission 2100-2200 continues on 11865 and 9545KC. To the Far East at 1315-1445 the 15255 channel is replaced by 11775KC. To the Near East from 1600-1700, 15255KC has been replaced by 15445KC.

TIRANA SCHEDULE

Radio Tirana in Albania has made some frequency changes in its English transmissions, according to a verification letter received from the station. This shows the new 7265KC channel as being used for a majority of the transmissions. The station is now operating as follows:

GMT	KC
0000-0030	7265
0600-0700	7265, 7090.
2000-2030	7265, 9390.
2200-2230	7265, 9390.

A Swedish report also states the 0600-0700 transmission has been heard on 11780KC on a test basis.

NOTES from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are GMT. Add 8 hours for Perth, 10 hours for Sydney and 12 hours for Wellington time. All frequencies in kilocycles.

BONAIRE TESTS CONTINUE

The Trans World Radio at Bonaire, Netherland Antilles, continues to test its new short-wave transmitters on new channels, and is now using one transmitter of 250 and one of 50KW.

The most recent tests have been on 6175 and 11955KC and heard at 0500GMT beamed toward Europe. The station has announcements in Arabic, French, German and English, and requests reports from its listeners. The new 6175KC channel provides the best reception, but at 0600GMT Paris in its transmission to Oceania opens on the frequency and further listening is not possible. The same happens on 11955KC, the BBC London using the frequency from 0600. Reception of Bonaire is weaker on 11955KC as compared to 6175KC.

CLANDESTINE STATIONS

In recent months many clandestine stations, so-called "freedom" radios have been noted on short wave. One which has been on the air for many years is "Radio Espania Libre," using 11680 and other channels at 0600GMT, and understood to be broadcasting from Roumania.

"Radio Portugal Libre" is heard from 1900-1930 and 2100-2200 on 9450KC. Location believed to be in Eastern Europe. "Voice of Truth," in Greek, is heard 0500-0530, 1200-1400 on 9933KC, and 1730 on 8065. Bulgaria is understood to be the site of this station. Turkish Free Radio, in Turkish, is heard at 2000-2100 on 5915KC. The station location is understood to be Bulgaria, according to the Swiss DX Session.

BROADCAST BAND NEWS

CYPRUS—A new frequency, 1520KC, for the Forces Broadcasting Service in Cyprus, has been observed at dawn. The FBS in the past has operated two stations on the island, on 1421 and 1439KC. The program is mainly from the BBC World Service in London and includes the BBC World News at 1800GMT. The major interference on the new frequency is from the Czechoslovak network of stations, which also use 1520KC and can be heard at dawn when signals from Europe are present.

JORDAN—The Jordan Broadcasting Service transmitter at Jerusalem is being better received on its new high power, possibly

150KW, and the station has a news bulletin in English at 1800GMT on 677KC. The other Jordan station, located at Amman and using 800KC, is the more consistent signal, and is heard at 1700GMT, when they have the home program in Arabic. The Jerusalem station has the slogan "The Voice of the Holy Land" in its newscast at 1800 and this program is followed by music with English announcements.

FLASHES FROM EVERYWHERE

CENTRAL AFRICAN Republic has verified John Bowyer, Melbourne, Victoria, with news that the station operates Monday to Friday 0530-0630, 1230-1500, 1600-2100, on Saturday and Sunday 0530-0630, 1230-2100, using the frequencies 5035 and 7220KC. The programs originate from the studios in Bangui.

TCHAD, also in Africa, has verified John Bowyer and gives its present schedule as Monday to Friday 0500-0600, 1200-2130, Saturday 0500-0600, 1200-2300, and Sunday 0500-2130, using 4904 and 7165KC. The transmissions come from the studios at Fort Lamey.

REUNION, with transmissions from St. Denis, is reported to be using the 120M band, and the frequency is now 2446KC. The station can be heard from 1730 and sign off is at 1830GMT after playing the French National Anthem. All transmissions are in French and at times give good signal level in Melbourne, according to Bob Padula.

CONGO station Radio Brazzaville is reported to be using 11725KC for French transmissions to sign off at 0730. The Brazzaville station at the same time gives fair signals on 15445KC with the same program, but seems to have dropped its former transmission to Oceania, which includes a news bulletin in English at 0515GMT.

SEOUL, in South Korea, is now opening at 0800GMT on 9640KC and causes some interference to the BBC London also on this channel to the Pacific. The Seoul station has been noted with English at 0830 and 1030GMT.

JAPAN recently made some frequency changes in the Radio Japan services from Tokyo. The station is broadcast to South Asia, in Hindi, English, Bengali 1500-1630 on 9525, 9765 and 11780KC. The General Service in English and Japanese 0000-0030 is on 6140, 15105, 15425, and at 2100-2130 uses 6140, 9605 and 15195KC.

SWEDEN has altered its Stockholm transmission times to South Asia and is now on the air 1445-1515, and in Swedish 1515-1600GMT, using 11915 and 15315KC.

ANKARA, in Turkey, is on the air in the service to Europe on 9744, 9515KC, 1845-2115GMT. The station now uses a new interval signal of eight notes on chimes.

SURINAM, site of the AVROS 5KW station at Paramaribo, is now on the air on 15465, but 15405 and 15450KC are also used. The station is on the air 0930-0330GMT. The station has been reported to be inactive, but a report from the West Indies DX Club gives the above information.

LIBERIA is the site of another new gospel station, which is to be built at Painsville, the site of the new BBC West African relay station. The new station, to be built by a Dutch Catholic organisation, will be using one 10KW and one 25KW transmitter, supplied and installed by Philips. Construction is expected to commence this month. No details as to schedule or frequencies, or opening date, are as yet known.

BEIRUT, in Lebanon, is now carrying its second program of the Home Service

on short wave, and has been noted using 7330KC, with English 1500-1700, and French 1700-2000GMT.

KIGALI station, in Rwanda, will now be on its new 50KW power, and its schedule will enable it to be received more clearly in this area. The station carries the program of the Deutsche Welle in Cologne, West Germany, and is listed on the following schedule: 7225KC, English, 0605-0635; Hausa, 0635-0650, and French, 0650-0725; 7260KC, English, 1615-1710, 2020-2050; French, 2050-2115; German, 1715-2005; also 7245KC, English, 0430-0500; French, 0500-0600GMT.

YEMEN is reported using 5804KC from Sannah from 1700 to 2200GMT. This frequency is well outside the normal 49M band and so is subjected to considerable morse interference.

PAKISTAN transmissions from the Karachi studios for its overseas listeners have been heard in English 0030-0115 on 9645, 11885KC; 0345-0445, 11885 and 17745KC. The service to the British Isles, 1945-2030, uses 9615, 11672, while a news bulletin at dictation speed is heard at 0810GMT on 17750KC.

RADIO CEYLON'S Commercial Service has often been found to be reluctant to verify, but recently its advertising agency, located in Bombay, has been authorised to verify reception reports, provided return postage has been enclosed. The address now for reports to the Commercial Service of Radio Ceylon is C/- Radio Advertising Services, P.O. Box 10013, Bombay 1, India.

WINDWARD ISLAND Broadcasting Service at St. George, Grenada is using a new 19M band channel, reports the Swedish DX Session. The station is on 15130KC 2145-2215, also noted on 15160KC from 2100 to sign off 2235.



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D Signal Injectors 171
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transistor audio oscillator.

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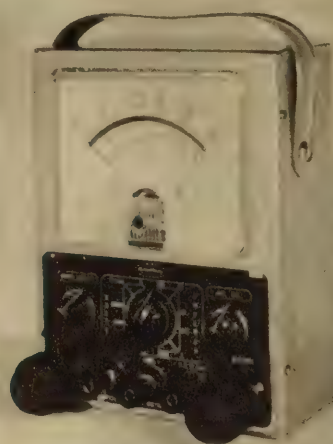
HEAVY DUTY AC-DC

INDUSTRIAL MULTIMETER MODEL MET

An industrial multimeter for checking the currents in solenoid, coils, condensers and motors.

Separate 100 ampere rated terminals are provided for the two higher current ranges and all terminals are fully insulated with non-removable tops. The meter has a 3½" mirror scale and a high torque movement with fully-hard, polished pivots spring loaded and end-stopped sapphire jewel bearings for maximum shock resistance and durability.

High stability carbon resistors, conservatively rated are used in series multipliers and low temperature coefficient manganin shunts are used for D.C. ranges. BS 89 accuracy.



SPECIFICATIONS:

- A.C. VOLTS: 0-10-50-250-1000.
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- A.C. AMPS.: 0-0.25-1-2.5-10-25-100.
- D.C. AMPS: 0-0.25-1-2.5-10-25-100.
- OHMS: 0-500 (centre scale 5½) and 0-50,000 (centre scale 550). Read .1 ohm easily.

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Box 1478V, G.P.O., Brisbane, Qld.
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and 134 Cambridge Street,
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AUSTRALIA'S LEADING MANUFACTURER OF ELECTRICAL INSTRUMENTS (A UNIT OF INSTROL)

EA2



THOUGHTS HAVE WINGS You Can Influence Others With Your Thinking!

TRY IT SOME TIME. Concentrate intently upon another person seated in a room with you, without his noticing it. Observe him gradually become restless and finally turn and look in your direction. Simple—yet it is a *positive demonstration* that thought generates a mental energy which can be projected from your mind to the consciousness of another. Do you realize how much of your success and happiness in life depends upon your influencing others? Is it not important to you to have others understand your point of view—to be receptive to your proposals?

Demonstrable Facts

How many times have you wished there were some way you could impress another favorably—*get across to him or her your ideas*? That thoughts can be transmitted, received, and understood by others is now scientifically demonstrable. The tales of miraculous accomplishments of mind by the ancients are now known to be fact—not fable. The method

whereby these things can be *intentionally*, not accidentally, accomplished has been a secret long cherished by the Rosicrucians—one of the schools of ancient wisdom existing throughout the world. To thousands everywhere, for centuries, the Rosicrucians have privately taught this nearly-lost art of the practical use of mind power.

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The Rosicrucians (not a religious organization) invite you to explore the powers of your mind. Their sensible suggestions have caused intelligent men and women to soar to new heights of accomplishment. *They will show you how to use your natural forces and talents to do things you now think are beyond your ability. Use the coupon below and send for a copy of the fascinating sealed free book, "The Mastery of Life," which explains how you may receive this unique wisdom and benefit by its application to your daily affairs.*

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Scribe J.S.M.

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Kindly send me a free copy of the book, "The Mastery of Life," I am interested in learning how I may receive instructions about the full use of my natural powers.

Name.....

Address.....

State.....

GMT. It would appear that the 15105-KC outlet has been moved to 15130KC.

OMALI Republic is also being reported over its other transmitter located at Hargeisa. It uses 4797KC and has been heard at 1700GMT relaying news from Radio Modagiscio, the main station in the Somali Republic. The country was formerly British and Italian Somaliland, and the two transmitters are those which operated in the former colonies.

MALAYSIA and **SINGAPORE** have made some frequency switching since they became independent. Radio Malaysia in Kuala Lumpur has a program in Malay on 5035KC at 1400, and use of this former Singapore frequency has meant that the Singapore station also now has a program in English at 1400GMT on 5005KC. The Singapore station on 11940KC has been noted on weekdays to sign off at 0830 and return to the air at 0930GMT.

AGOS in Nigeria is reported now using three frequencies for the English news session at 1700GMT. The Nigerian station has been reported on 9690, 11900, and 15255KC. The Lagos station has also been noted at 0600 when using 4990KC in the morning service of the Nigerian Broadcasting Corporation.

LGIERs has been noted with the French program of the Radiodiffusion Television Algiers, using the new frequency 9685KC from sign on at 0630GMT. The new outlet opens with the interval signal, and at 0630 a time signal, the anthem and then opening announcements in French. At 0730 a news bulletin in French has been observed and signals fade out after 0800 when popular music is being played. Our reception was fair, the main interference being sideband interference from the A.B.C. Melbourne transmitter on 9680 KC.

OOK ISLAND has been heard by one of our South Australian readers, Chris Whitfield of Dover Garden, when the Raratonga station was using 9695KC. This special transmission at 0730 was heard when a program for reception in New Zealand was carried. The station is using 5045 and 3268KC for its regular services.

ULGARIA is reported to be using another frequency outside the normal 49M band, and Sofia transmissions have been heard at 1900GMT in Greek on 5940KC, as well as the old channel of 7670KC. Both these frequencies are outside the usual recognised short-wave bands, and the Swiss DX session reports good signals on both frequencies.

AVANA is carrying the transmissions of Radio Havana Cuba in English to Europe 2010-2140 on 11735; North America 0300-0430, 0500-0600 on 6135; South America 2050-2150 on 11760; in French to Middle East 0700-0730, 0900-0930, 1800-1830, 2110-2140 on 11705; and to Europe in French 1900-2010 on 11735 and French to North America 0430-0500 on 6135KC. Arabic transmissions to the Middle East are on 11705KC and broadcast, 0730-0830, 0930-1030, 1810-1855, and 2030-2110.

ONAIRE continues to test the frequencies assigned to the Trans-World Radio station, and we have been hearing a transmission beamed to Europe at 2200GMT on 15245-KC with some side interference from Radio Australia. Other frequencies noted include 15255, 15180, at 1930-2030; and the Radio Netherlands transmission on 15165 from 2000-2050 in English to Africa, using the Bonaire relay for this transmission.

EPAL has now been heard with a news bulletin in English at 1500GMT, by Ern. Suffolk, of Adelaide, when the station has been tuned on 4600KC. The Nepal Station is on the air 1320-1520, and has now been heard by several listeners in this area, who will be anxious to receive their verification of reception from the Katmandu station.

TECHNICAL BOOKS AND PUBLICATIONS

For Administrators, Engineers . . .

WRITTEN COMMUNICATION IN BUSINESS, Second Edition, by Robert L. Shurter and J. Peter Williamson. Cloth bound, 6in x 9in, 503 pages, with 27 illustrations. Published by the McGraw-Hill Book Co., New York. Price in Australia 100/.

Every so often, an academic or an administrator complains that today's students or trainees or engineers or scientists can't express themselves clearly. That they can't write a report or paper, or can't spell, or that they don't know how to write a standard business letter.

Like the charge of "irreverence and disrespect" perennially directed at youth, such criticisms have been made quite regularly since Aristotle's time—probably long before. And there's little doubt that they'll be made at least as regularly in the future.

However it does seem that with the growing technical complexity of our culture there has been a steady increase in the number of people unable to express themselves adequately. And it would seem that technical people are most liable to suffer from this limitation; the scientist and the technologist often have so much factual material to absorb that techniques of expression and communication must be relegated to the position of "something to be picked up along the way."

The problem, while understandable, is none-the-less a serious one. Quite apart from the large-scale wasted effort produced by ineffective inter- and intra-discipline communication, there are the more personal problems for the individual: if he hasn't managed to "pick it up along the way," what does he do when he must write a report, or deliver a paper, or send an important letter? Or when he suddenly finds himself promoted from the familiar and impersonal laboratory into the chief-engineer's or research director's office?

The answer, no doubt, is that he'll employ the same tactics he uses when confronted with a design or research problem; to scour through the library or bookshop for a suitable reference.

With luck he'll find a copy of Shurter and Williamson's book, and the find should make a large contribution towards solving his problem. For "Written Communication in Business" seems to me to be an exceedingly practical volume, and one which should be of considerable use to technical people—inhabitants of commerce and ivory-tower alike.

The authors are both academics: Dr Shurter is Professor of English at the Case Institute of Technology, and Dr Williamson is Associate Professor of Business Administration at Dartmouth College. They have used their academic training to good advantage to produce a book which is both logically ordered and arranged, and practically orientated—a somewhat rare combination.

The main section of the text is divided into five parts, dealing with:

- (1) Principles of Business Communication.
 - (2) Technique of Business Letters.
 - (3) Specific Types of Business Letters.
 - (4) The Report and Memorandum.
 - (5) Self-Development on the Job.
- Each of the five parts is in turn subdivided into chapters. For example, the chapter headings of part four read:
- (14) Purpose in Report Writing.
 - (15) Research, Data, and Reasoning.
 - (16) Organisation of a Report.
 - (17) Putting a Report Together.
 - (18) Beginnings and Endings.
 - (19) Some Matters of Form.

Within the chapters the text reads

smoothly. The writers use fairly terse but lucid style, with plenty of illustrative examples. They certainly appear to follow the principles which they advocate regarding directness, simplicity of expression and frequent use of the active voice.

Following the main section of the text there are some thirty pages of illustrative cases, mainly concerning commercial letter-writing and administration. The cases are arranged in the form of self-tutorial problems. The book ends with a reference section discussing parts of speech, sentence construction, punctuation and the "Mechanics" of writing: inserting numbers into prose, when to capitalise, when to italicise, how to footnote, preparing a bibliography, spelling rules, forms of address, etc.

In short, a most useful and practical reference volume for anyone who needs help in expressing themselves adequately in writing. Which probably includes quite a few of us . . .

A worthy addition to the reference shelf of any professional or businessman.

Our copy came direct from the publisher, but we understand that copies are obtainable at all major bookshops. (J.R.)

★ ★ ★

TRANSISTORS, THEORY AND APPLICATIONS, produced and published by the Philips Electron Tube Division. Soft cover, 5½ by 8 inches, 253 pages of text including many tables, illustrations and colour plates. Australian price 15/ (approx.).

This book is divided into seven sections. Basic Principles, Further Consideration of Transistor Theory, Transistor Constructions, Transistor Characteristics, Stabilisation, Basic Transistor Circuits and Practical Circuits. The last 10 pages are devoted to technical data of semi-conductor devices marketed by the publishing company.

The practical circuits featured include several audio amplifiers, radio control receivers, relay control circuits, light operated equipment, temperature control, frequency meters and many more.

In fact, the subject of semi-conductors is treated very thoroughly, the text matter taking the beginner into the subject and guiding him through to a quite excellent understanding of the principles involved.

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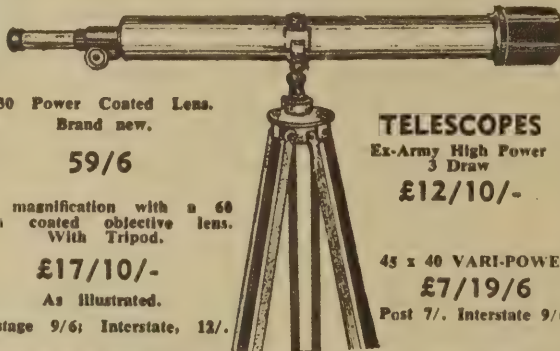
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Every point made is well illustrated and the reproduction of photographs and colour plates is extremely good. The quality of the paper used in the publication alone would lead the purchaser to believe that this would be an expensive book—which is certainly not the case.

We can recommend this publication to students and those who wish to add a good reference text to their library. Our copy came direct from the publisher, but we understand that copies will be available from all major booksellers. (K.W.)

★ ★ ★
VHF ANTENNA HANDBOOK, by Jim Kyle, KSJKX. Soft cover, 8½ by 10½ inches. Sixty-one pages of technical material with illustrations. Published by 73, Inc., Peterborough, New Hampshire, U.S.A. Price 25/- Post and packing 1/3.

This book is a compilation of antennas which are of use particularly in the VHF range, as the title suggests. While the publication is intended especially for amateur use, it will be found useful to others also interested in VHF antennas. Indeed, much of the information could be applied to antennas in the high frequency range.

A list of chapter titles will convey some idea of the aspects covered. They are: (1) Basic Concepts, (2) The Dipole and its Relatives, (3) Phased Arrays, (4) Parasitic Arrays (Yagis), (5) Circularly Polarised Antennas, (6) Non-Resonant Antennas, (7) Reflective Antennas, (8) Practical Antenna Techniques.

In addition to these chapters, there is a manufacturers' section, with a listing of VHF Antenna Manufacturers (American) and details of their products. Finally, the amateur and photo section gives details and photographs of antenna systems belonging to top American VHF men.

As may be seen from the contents, the author has started "at the beginning," with basic antenna theory. This is followed by descriptions of a large number of antenna types, reinforced with information on constructional techniques. Explanations are clearly presented and easy to follow. The style is light, almost breezy in places, but is felt that this is not of any real consequence.

Our copy came from Technical Book and Magazine Company Pty. Ltd., 295-299 Swanston Street, Melbourne C.1. (I.L.P.)

★ ★ ★
RADIOTRONICS for July, 1965 (Vol. 30, No. 7) has articles on a high quality transistorised audio preamplifier and tone control, a regulated variable transistor power supply, and on achieving high performance in VHF/UHF tuned amplifiers. The Amalgamated Wireless Valve Co., P.O. Box 63, Rydalmere, N.S.W. Annual subscription 20/-.

RADIOTRONICS for August, 1965 (Vol. 30, No. 8) has articles on the construction of ceramic pickup cartridges, implosion protection for picture tubes, and a regulated bias supply capable of supplying two separate circuits with up to 50V at 100mA. The Amalgamated Wireless Valve Co., P.O. Box 63, Rydalmere, N.S.W.)

MULLARD TECHNICAL COMMUNICATIONS for March, 1965 (Vol. 8, No. 75) has articles on gallium arsenide semiconductor devices, transient performance of heatsinks for power devices and operating principles of the Z504S stepping tube. Mullard Limited, Mullard House, Torrington Place, London, W.C.1. In Australia, 5-43 Clarence Street, Sydney.)

MULLARD OUTLOOK for July-August, 1965 (Vol. 8, No. 4) has major articles on a street lighting controller using a photoconductive cell, a five-watt transistorised high-quality amplifier, microwave cooking (part 3) and ferroxcube for transformers. Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney.)

MINIWATT DIGEST for September, 1965 (Vol. 4, No. 12) has main articles in a new monolithic semi-conductor integrated circuit amplifier for use in "in the ear" hearing aids, type OM200; application

of the new unit; a selection guide for high power rectifiers; and part 2 of a series of articles on photosensors. (Miniwatt Electronics Div., Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W.)

HEWLETT-PACKARD JOURNAL for August 1965 (Vol. 16, No. 12) has articles on a new digital voltmeter of .005 per cent accuracy, and on guarded measurements with a floating voltmeter. (Australian Agents for Hewlett-Packard are Sample Electronics (Vic.) Pty. Ltd., 9-11 Cremorne Street, Richmond E.1, Victoria.)

H-P MEASUREMENT NEWS for August/September announces a compact 2MC digital counter, a DC null voltmeter, a pulse generator for 2.5nS pulses up to 10V to 100MC P.R.F., a new frequency synthesiser, and a strip-chart recording plug-in for the 175A oscilloscope. (Hewlett-Packard agents in Australia are Sample Electronics (Vic.) Pty. Ltd., 9-11 Cremorne Street, Richmond E.1, Victoria.)

B.B.C. ENGINEERING MONOGRAPH NO. 57 (June, 1965) deals with the problem of drop-out in video tape recording. Written by W. K. E. Geddes, of B.B.C. Research, it includes details of a simple drop-out compensator. (Five shilling from B.B.C. Publications, 35 Marylebone High Street, London, W.1.)

NATIONAL BUREAU OF STANDARDS TECHNICAL NEWS BULLETIN for July, 1965 (Vol. 49, No. 7) has major articles on the effect of light on semiconductor film growth, ionic collision processes, the behaviour of aluminium under strain, and the study of denture fitting. Details are given of new calibration services and standards. (Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402.)

STC COMPONENTS AND EQUIPMENT REVIEW for August, 1965 (Vol 2, No. 8) has a major article on the tunnel diode. Other data describes a new moving coil microphone, sub-miniature relays, the MTR 25-131 VHF radiotelephone and other components. (Industrial Products Div., S.T.C., Morebank Avenue, Liverpool, N.S.W.)

TECNICO ELECTRONICS announce that they have available some 70 booklets dealing with the Hall effect and its applications. The booklet gives details of the Bell Hall-Pak Kit described in the article in this issue. The booklets are available by applying on company letterhead to Tecnico Electronics Pty. Ltd., 53 Carrington Road, Marrickville, N.S.W.

THE STANDARD ASSOCIATION OF AUSTRALIA has issued a fourth booklet of amendments to the 1961 edition of Part 1 of the SA Wiring Rules. This amendment No. 4 includes amendments to some ten of the rules. Copies are now available from the various offices of the Standards Association in the State capital cities and at Newcastle. The price is 1/- a copy, plus postage.

THE STANDARDS ASSOCIATION OF AUSTRALIA announces the issue of a series of amendments to the following approval and test specifications:

C100 — amendment No. 2; C101 — No. 10; C112 — No. 2, C117 — No. 8; C118 — No. 8; C119 — No. 3; C120 — No. 1; C122 — No. 1; C125 — No. 8; C126 — No. 6; C126 — No. 6; C128 — No. 9; C140 — No. 3; C151 — No. 4; C152 — No. 5, C153—No. 7, C156—No. 8, C157 — No. 7, C160 — No. 6, C162 — No. 3, C163—No. 5, C168—No. 1, C169—No. 1 and C172—No. 2.

Several of the amendments, including that to C100, deal with "on" and "off" marking of switches incorporated in various appliances. There is a charge of 1/- each applying to the amendments to C101 and C117, and of 1/6 each to the amendments to C126 and C152. Other amendments are available from the Association without charge, other than for postage.

DUCON CONDENSER PTY. LTD., have released Engineering Bulletin No. EB 408, dated July, 1965, dealing with ceramic capacitors, and in particular with tubular types CTR and CTP. Information given includes capacitance and tolerance ranges, electrical specifications and physical sizes of current production. For further details, or a copy of this bulletin apply to Ducon Condenser Pty. Ltd., Box 2, Villawood, N.S.W.

J.S.H. ELECTRONICS COMPANY has available price lists for microwave tubes, transmitting valves, camera tubes, special valves and semiconductors from some 32 American and continental manufacturers, including Du Mont, Amperex, Raytheon, Heintz and Kaufman, Siemens and Varian. J.S.H. Electronics Company, 8549 Higuera Street, Culver City, California, 90231.

SIGMA INSTRUMENTS INC., Braintree, Massachusetts 02185, have available detailed product bulletins describing AC and DC versions of a new low-cost, multi-purpose Series 46B DPDT relay for 10-ampere load switching from 1 volt-ampere or 500-milliwatt input signals. These relays are recommended for such applications as energising hydraulic valve solenoids for automatic machine tool control, providing electronic timer output, and controlling fractional horsepower motors. Bulletins illustrate unique relay design that eliminates internal switch wiring and assures high-efficiency load switching life-rated to 10 million operations. Complete electrical, mechanical, and environmental specifications are included.

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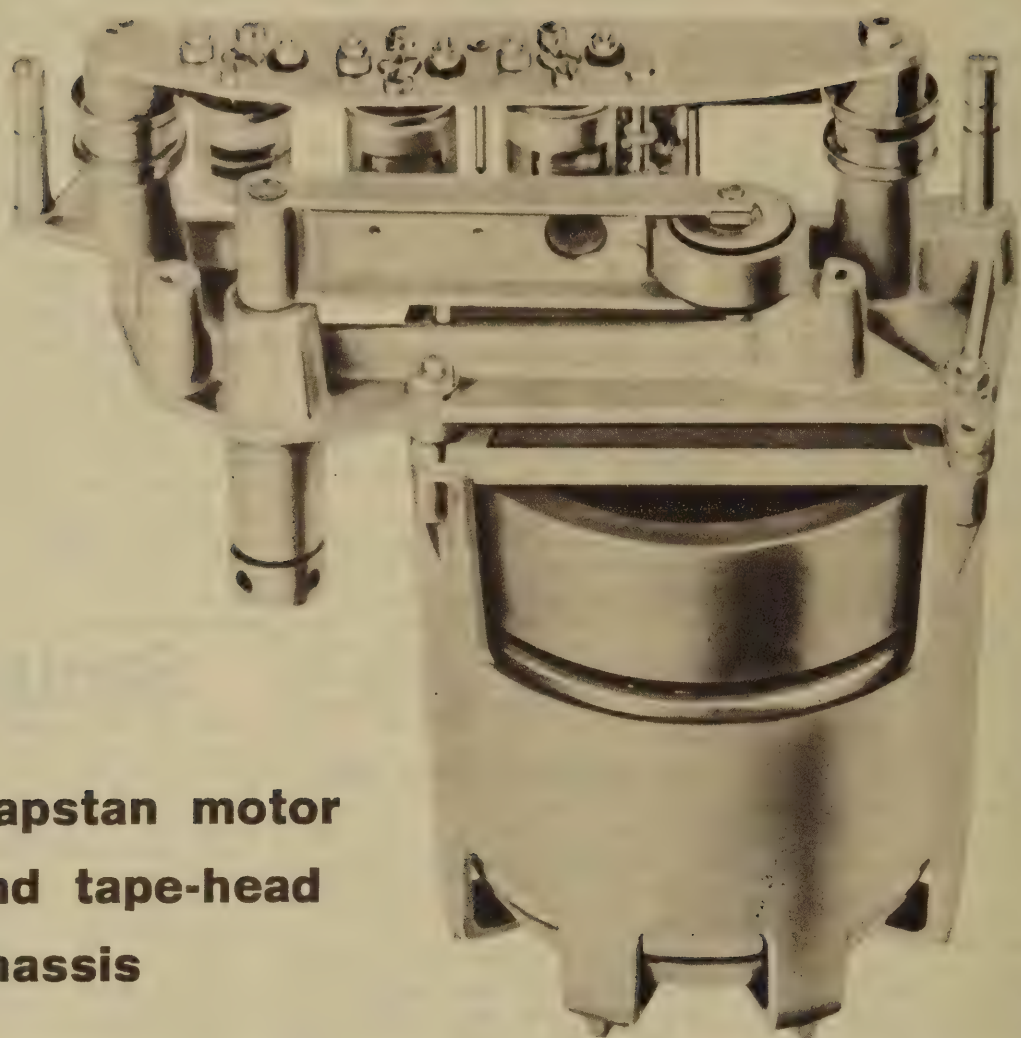
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UNDERWATER AMPLIFIER

G. D. (Matraville, N.S.W.) says that a small transistor amplifier which he built, along the lines of our "Transistor Eight" audio end, went down with a boat and spent 3 days on the bottom of Botany Bay. It was later washed in fresh water and dried out and worked in a fashion upon fitting with new batteries. A new switch, a new capacitor and a new speaker restored it to normal.

As you observe, G. D. such an experience speaks well for the durability of modern equipment. Publishing your letter makes us fearful on one point, however: A heap of correspondence from other readers determined to top your story!

PRACTICAL CIRCUIT

E. B. (Wellington, N.Z.) sends in the circuit of a variable power supply, for possible use in our "Reader Built It" page.

Thank you for your letter. While not novel, the device is certainly very practical and we will endeavour to publish it at the first opportunity.

FM TUNER

J. A. (Regents Park, N.S.W.) writes to support C.E.G. of North Balwyn, Victoria (August 1965) in his request for an FM tuner to receive TV sound signals.

Many thanks for your comments A. J. and, as we said in the August issue, we will certainly keep this idea in mind. However, yours is only about the second request we have had so far, and we would need more indication of a demand before we could justify the work involved in such a project.

VARY TAPE SPEED?

B. A. (Mooney Ponds, Vic.) recently bought a small battery-operated tape recorder using a 1.5V motor. He is concerned because the motor has no variable speed control, and he would like information regarding a potentiometer or rheostat to vary the speed.

Strictly one would have to know a good deal more about the motor and its existing governor system, A.B., but we imagine that a 6-10-ohm pot wired as a rheostat will give some speed control. Note however, that the use of a rheostat may introduce undesirable speed instability. A more refined system using a voltage regulation circuit would give better results, but the cost would probably make it impractical.

S/W CRYSTAL SETS

W. W. I. (Corio, Vic.) writes asking whether a crystal set may be used to receive short-wave broadcasts, and, if so, where he may obtain the circuits necessary.

Unfortunately a crystal set is a very inefficient receiver and relies on a strong signal for reasonable reception. Its ability to pick-up signals at a readable strength

diminishes rapidly as distance from the transmitter increases. Therefore, unless you are situated close to short-wave transmitters, there is very little chance of receiving these stations. Also the selectivity of a crystal set leaves a lot to be desired and it is possible that, even if a local short-wave station could be received, it would suffer interference from local broadcast stations. We suggest that you consider building a two or three transistor receiver with plug-in coils which will provide broadcast and short-wave reception. Suitable circuits are available for 2/- each from our information service.

SMALL VALVE SETS

G. R. (Macclesfield, S.A.) writes requesting more small receiver circuits using about three valves and mentions his success in building the "Minivox" mentioned in the May, 1965, edition.

Of later years we have featured mostly transistorised small receivers as the cost of components usually compares more than favourably with valves, power transformers, etc. However, we can supply circuits from past editions for anyone requiring to build small valve receivers and will certainly keep the idea in mind of producing more small valve receivers suitable for beginners.

TRANSFORMERS, VALVES

G. F. (Glenroy, Vic.) writes asking if it would matter in an output transformer if the primary winding is wound above or below the secondary winding. Also, he asks what do the numbers and letters on valve and transistor type numbers represent.

Depending on the transformer application the windings may be interchanged and in some special applications even interwound. Your question is too general to give a specific answer but you would probably be able to achieve comparable results either way round. It is an unfortunate fact that a great number of the valves and transistors available have type numbers that do not actually tell anything about the function of the valve. European type numbers are an exception and the first letter is an indication of the heater voltage and the following letters the type of valve. For instance an EC88 would be a 6.3 volt heater (E) and a single triode (C). If a second C was used in

the type number it would indicate a twin triode. Unfortunately we do not have the space to list the complete code for these valves. Just recently a new coding system of the same nature was started for transistor identification. In reference to your query re using a 400-volt electrolytic in place of a 12-volt electrolytic, this would be acceptable as long as the electrolytic has been formed recently. In other words if a second-hand electrolytic is to be used it would be wise to connect it across a 200-300 volt source for a while to make sure the electrolytic film is formed.

TRANSFORMER TAP

R. C. W. (Epping, N.S.W.) writes to suggest a modified form of power transformer secondary winding, whereby an extra tap is provided at the opposite end of the winding to that normally used for the tapping. While not claiming that the idea is new, he points out the advantages of such a tap particularly in modern voltage doubler circuits, which would reduce the number of transformer types which would need to be stocked and help the experimenter.

Many thanks for the suggestion R. C. W. As you say, the idea is not new and, in fact, has been used commercially as a means of obtaining a larger range of voltages than possible with the maximum practical number of taps. Whether there would be sufficient incentive for the transformer manufacturers to provide this arrangement on conventional transformers is another matter, and would depend mainly on demand. In any case, some types currently available have been designed for maximum versatility, as for example the one used in the Powered Monitor (September, 1964) and the Photo-Timer (August, 1964). Nevertheless, we will pass the idea on to them at the first opportunity.

ELECTROPLATING

I.G. (Willoughby, N.S.W.) writes praising the article on Plating at Home. However, he mentions difficulty in obtaining the gold and silver salts.

We suggest that you contact the firm mentioned in the article, Matthey Garrett Pty. Ltd., as they are definitely able to supply these materials. This firm has offices in Sydney, Brisbane and Richmond, Victoria. The Sydney address is 824 George Street.

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Conditions governing this service are set out below:—

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- (2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.
- (3) For the 2/- fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel. Where articles are not on file we can usually provide a photostat copy at 2/- PER PAGE.
- (4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.
- (5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.
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PROGRAM SOURCE

(Continued from Page 48)

of the audio system, the resistor can be made somewhat smaller. The extra resistor can be introduced into circuit whether the simple detector is used, or the full whistle filter system.

To align the short-wave band, it should be necessary to give attention only to the two cores and two trimmers, it being assumed that the IF transformers will already have been aligned.

Tune to a short-wave station towards the low frequency end of the band and, rocking the dial slightly to keep it in tune, adjust the core of the aerial coil for maximum signal strength. Then find a station near the high frequency end and, following the same procedure, adjust the aerial coil trimmer.

If a calibrated signal generator is available, or if one or more short-wave stations can be identified, the frequency coverage can be brought into line with dial calibrations by suitably adjusting the cores only at the low frequency end of the band, followed by the trimmers only, at the high frequency end of the band.

As mentioned earlier in the article, it is important to have available the full sensitivity of the IF channel if good short-wave performance is to be realised. To this end, any neutralising capacitor in the IF channel should be kept to the smallest possible value consistent with stability. If you can do without it, so much the better. ■

FORUM

(Continued from Page 71)

which would be free of the foregoing objections . . . or some of them.

For example, if you look at the article elsewhere in the issue on Hall Effect devices, you will discover therein the sweetest frequency doubler that ever was. Put in F plus F and out comes 2F plus a DC component, which can be readily disposed of.

But—and what a but it is—while it would be a most effective doubler for single tones, it would equally be a most effective intermodulator for multiple tones. And I doubt if there's any sound more unpleasant than thoroughly intermodulated audio.

I fear that, on this rock, the whole idea of "Alvin Generation" per frequency doubling must founder, method notwithstanding. ■

ELECTRONIC MUSIC

(Continued from Page 107)

a second and more elaborate instrument. The second RCA Electronic Music Synthesizer was placed in use at the Columbia-Princeton Music Centre at its inception in 1959.

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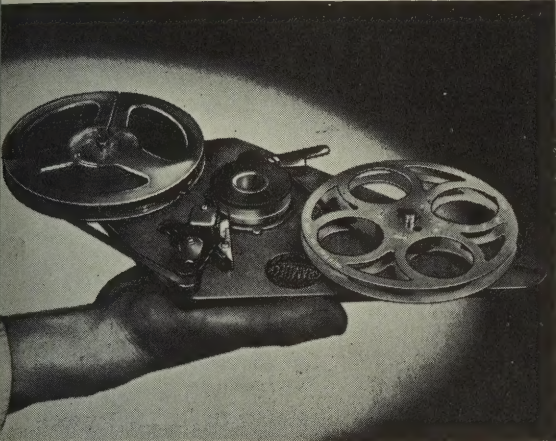
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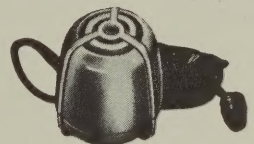
QUESTIONS AND ANSWERS ABOUT AN UNUSUAL TAPE RECORDER



TAPE DECK



CONTROL UNIT



600 OHM MOVING
COIL MICROPHONE

How you can have a superb Tape Recorder at a fraction the usual cost:

IF I CAN AFFORD A GOOD CONVENTIONAL TAPE RECORDER, WHY SHOULD I CHOOSE A GRAMDECK?

Because you get BETTER results at far less cost. When you buy an ordinary tape recorder, you are buying **all over again** items which you already possess in your gramophone or record-player — motor, speaker, valves, transformer, amplifier, etc. These items, with many other delicate components have to be put into the relatively cramped space of an ordinary tape recorder, so they are small and not as robust as the components of your record-player.

Remember also that Gramdeck has a facility found in only a few of the most expensive tape recorders — you can record music or background sounds and, without erasing the recording you have already made, you can superimpose any voice on top of it.

YOU SAY I SHALL GET BETTER REPRODUCTION WITH GRAMDECK. WHY?

A conventional tape recorder has a small speaker and not much room for a first-class amplifying unit such as you have on your radio, gramophone, etc. The speaker you possess now, for instance, is probably some 9in across, whereas in the standard tape recorder it is only about 4in. Gramdeck gives you precisely the tone-quality and fidelity you now enjoy from your record-player, or radio. IT USES THE VOICE OF YOUR OWN INSTRUMENT.

IS THERE ENOUGH TORQUE (TURNING-POWER) ON MY TURNTABLE MOTOR?

Unless it is worn out or very old, there is power to spare. The torque or turning-power needed to drive the Gramdeck reels (measured in gram-centimetres) is 120 to 60. Most record-players comfortably provide 253 to 300 gram-centimetres torque, with no more than 1% speed change.

HOW CAN I SATISFY MYSELF THAT GRAMDECK SOUND QUALITY REALLY IS BETTER THAN THAT OF ORDINARY TAPE RECORDERS?

Words cannot possibly do justice to the superb quality of recording and reproduction you get from the Gramdeck. The only way to satisfy yourself that it really is first-class is to **HEAR IT**. We are confident you will be astonished and delighted.

Twin track head? Yes.	Fit on record changers? Yes.
Automatic erase? Yes.	Tapes any speed? Yes.
Erase without recording? Yes.	Easy to fit Yes.
Superimpose? Yes.	Spool sizes up to 5½in? Yes.
Record direct from radio? Yes.	Very reliable? Yes.

These unique Tape Recorders are imported from England and sold direct by the Agents at the quite remarkable price of £24/10/ for the complete unit (Tape Deck, Pre-amplifier and Microphone).

DETAILS FOR THE TECHNICAL MAN CONTROL UNIT (PRE-AMPLIFIER)

Output voltage from CCIR test tape, or average program level, 0.25 volts rms. Noise: Better than 3 mV rms. Response: Playing EMI or CCIR test tape, Plus of minus 3dB from 60 to 10,000 c/s. Record/Replay, same as above.

TAPE TABLE

Output at peak recording level 4 mV rms. Impedance: 700 ohm at 1 Kc/s. Inductance: Nominally 120mH. Gap vertical: Nominal width 0.00025in. Top-track recording. Wow and Flutter (from tape table only) better than 0.15% rms, measuring all components from 0—300 c/s. With transcription turn-tables better than 0.2%. With commercial gramophones of changers, better than 0.3%.

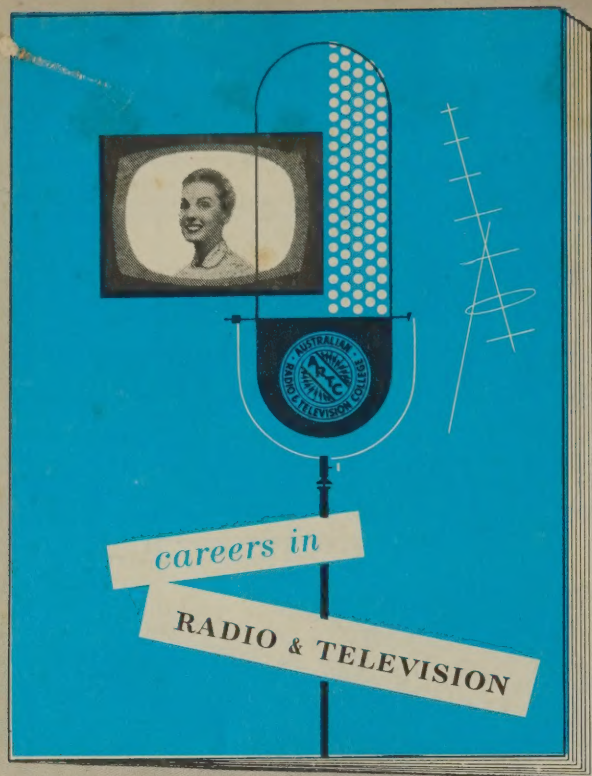
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166 Glebe Road, Glebe, N.S.W.
Telephone 68-1014**

**BRISBANE AGENCIES
16 Stanley Street,
South Brisbane, Qld.
4-5466**

Please forward, free and post free, your 16-page booklet on the Gramdeck Tape Recorder described on this page.

Name
Address
State

THIS FREE BOOK COULD BE THE TURNING POINT IN YOUR CAREER



ASK YOURSELF THESE 3 QUESTIONS

1. Am I in a dead-end job?
2. Can I use my spare time to get ahead?
3. Am I capable of earning more money?

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Thousands of ambitious men have realised the benefits offered by A.R.T.C. training and are now making money in radio. You can join the ranks of the skilled men. . . and it costs only pence a day.

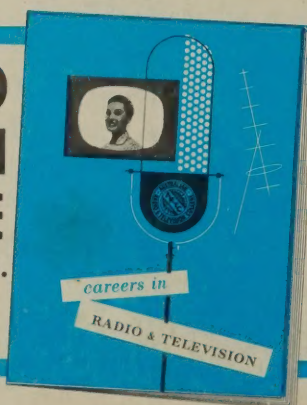
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